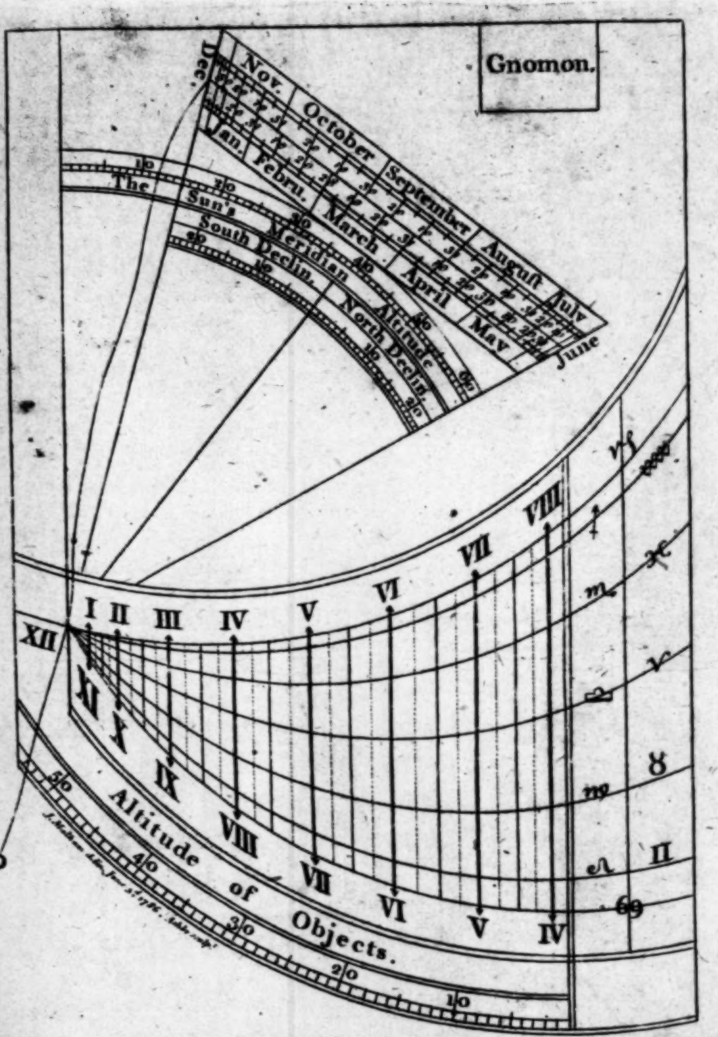
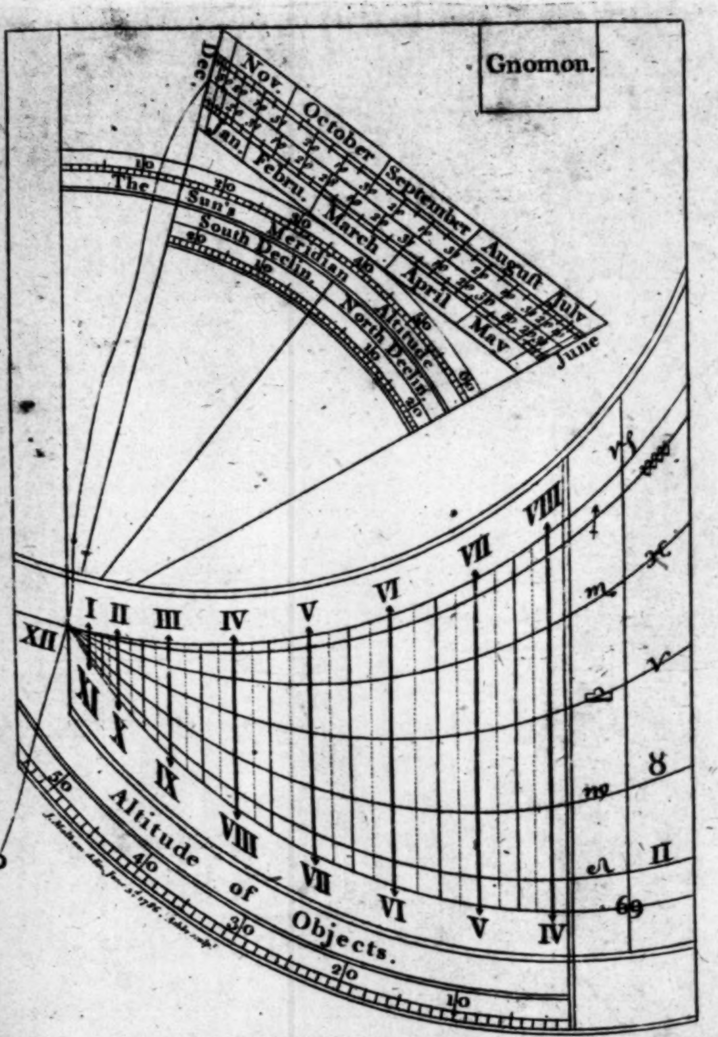


USE, Having cut the middle black Line amongſt the Months very nicely, put a Silk Thread through it, faſten it behind, and put a Bead on to move, with a larger one at the End to Stretch the Line. Move the Thread to the Day of the Month, and the Bead to XII, and it will cut the Sun's Meridian Altitude and the Declination, and by turning the Dial upright, the Line, if left at liberty, will ſhew at what time the Sun riſes and Sets that Day, and the Bead will ſhew the Parallel of the Sun's Place. — To find the Hour, raiſe the Gnomon & hold the Dial ſo that the upper Edge may ſhade the upper Line of the Dial exactly, & the Bead at liberty below will ſtrike the Line of the Hour either Morning or Afternoon. The Altitude of any Object may be taken by two Gnomons.



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THE

YOUNG MAN's NEW UNIVERSAL COMPANION;

OR,

Gentleman's Pocket Intelligencer.

CONTAINING,

I The Principles of the Engliſh Language; Directions for Writing; Specimens of Letters; Forms of Addreſs; and Rules for Penmanſhip.

II Forms of Wills and Deeds; Notes, Receipts, Bills of Parcels and Book Debts, with many other Mercantile Matters, as Shipping, Invoices, and the Nature of Exports and Imports.

III. Arithmetic in general; Vulgar and Decimal Fractions; Extraction of Roots, and their Uſes; Duodecimals and their Application to Artificers' Works; Board and Timber Meaſure.

IV. Chronology and Geometry, with ſome of their moſt uſeful Problems; Plain Trigonometry; the Geography of Maps; Navigation and Aſtronomy, including a full Account of the Georgium Sidus, or New Planet. Dialling, with the newly-invented Pocket Card-Dial. The colouring of Dial-Boards, and preparing Colours for beautifying Maps, &c.

V. The Menſuration of ſuperficial and ſolid Bodies. Eaſy Methods of ſurveying Land. Caſk Gauging. Information to Cuſtom-houſe Officers.

VI. Directions for Swimming. Recovery of Drowned Perſons. To eſtimate the Value of Life and Leaſehold Eſtates upon two or three Lives, &c. &c.

BY THE LATE MR. D. FENNING,

AUTHOR of the UNIVERSAL SPELLING BOOK, READY RECKONER, YOUNG MAN's BOOK of KNOWLEDGE, NEW GRAMMAR OF THE ENGLISH TONGUE, &c. &c.

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PREFACE.

THE eſtabliſhed character of Mr. Fenning's many valuable and well known books, for the uſe of ſchools, renders it altogether unneceſſary to make any long addreſs on the preſent occaſion, eſpecially to thoſe who are already acquainted with his other publications; but as this work may fall into the hands of ſome young perſons and others, who have not had this advantage, and, beſides, as it is but in part compiled by himſelf, it may not be improper for the Editor to ſay a few words as to its deſign and execution.

As the acquiſition of uſeful and practical knowledge, and the diffuſion of it among the young and uninformed part of the ſpecies, was Mr. Fenning's ruling paſſion, it is natural to conclude, that he had finiſhed this, and perhaps ſome other works, before his deceaſe. Part of the manuſcript, however, was unhappily loſt; but ſo much of it, at the ſame time, was by good fortune preſerved, as to ſhow the particular objects the Author had in view in planning the production. The proſecution, therefore, of theſe views, and the continuation and completion of the work, was left to the Editor; and as he has not the vanity to think (whatever may be his knowledge in other reſpects) that he has the more rational notions with regard to the education of youth, than the late Mr. Fenning, who perhaps judged as wiſely in that reſpect as any man that ever exiſted, he has endeavoured, as far as he could, to adhere to the plan, which, he imagines, the Author would have purſued, had he lived to finiſh the performance.

In purſuance of this deſign, and in order to render the work (what the Author ſeems to have intended it) an eaſy introduction to the Young Man's Book of Knowledge, the Editor has introduced, and treated at ſome length, as great a variety of ſubjects, as the narrow limits, to which he was confined, would poſſibly admit. To have introduced a greater number would have obliged him to treat each of them in ſo ſlight and ſuperficial a manner, as to make them of little uſe; and to have introduced a ſmaller, would at once have been diſappointing the reader's juſt expectations, and falling ſhort of the original deſign which the author had formed. What the particular ſubjects are, will partly appear from the copious title-page, and ſtill more fully from the Index or Table of Contents; and it is hoped, that the reader, on a careful peruſal, will find them to be both ſo numerous and important, and to be treated, though briefly, yet ſo diſtinctly, as to beſtow upon the book a decided ſuperiority over every thing of the kind, and to ſhew that it juſtly merits the title, we have given it, of the YOUNG MAN'S NEW UNIVERSAL COMPANION.

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☞ *The Binder is deſired to place the Plate of the* **CARD DIAL** *between P.* 320 *and* 321.

THE
YOUNG MAN's
NEW
UNIVERSAL COMPANION.

The FIRST PRINCIPLES of the ENGLISH LANGUAGE.

AS every man who is raiſed but one degree above the very loweſt of the vulgar, ought to be able to ſpeak and write his mother tongue, if not elegantly, at leaſt grammatically and correctly, I ſhall here endeavour to lay before the reader a ſhort but comprehenſive view of the firſt principles of the Engliſh language.

ORTHOGRAPHY.

ORTHOGRAPHY is the art of writing words right, and likewiſe of pronouncing them properly.

The Engliſh Alphabet conſiſts of twenty-ſix letters, namely,

A, a; B, b; C, c; D, d; E, e; F, f; G, g; H, h; I, i; J, j; K, k; L, l; M, m; N, n; O, o; P, p; Q, q; R, r; S, ſ; T, t; U, u; V, v; W, w; X, x; Y, y; Z, z.

Theſe letters are divided into vowels and conſonants. The vowels are *a, e, i, o, u, y*. All the reſt are conſonants. *Y* indeed is ſometimes a conſonant as well as a vowel. It is a conſonant in the beginning of words, as *yes, yet, your*. In the middle and end of words, it is always a vowel, as *flying, crying, fly, cry*.

The

The different ſounds of theſe letters, whether taken ſeparately, or united together, are ſo well known to every Engliſhman, that I ſhall not take up much time at preſent in enlarging upon them. Beſides, it may be obſerved, that it is as impoſſible to communicate the true ſound of letters in writing, as it is to make a man hear with his eyes, or ſee with his ears, or to ſubſtitute one ſenſe in the room of another. A few curſory remarks, however, may not be improper.

E at the end of words commonly lengthens the preceding vowel, as *bar*, *bare*; *car*, *care*; *far*, *fare*; *mar*, *mare*; *ſtar*, *ſtare*; *din*, *dine*; *fin*, *fine*; *pin*, *pine*; *cag*, *cage*; *rag*, *rage*, *wag*, *wage*; *cub*, *cube*; *tub*, *tube*

I is ſometimes ſounded like *ee*, as in *bombaſin*, *capuchin*, *machine*, *magazine*, and a few other words.

O is ſounded like *oo* in *do*, *Rome*, *tomb*, *womb*. In *women* it is pronounced like *i*, as *wimen*. *C* ſounds hard, like *k*, before *a*, *o*, *u*, *l*, and *r*; as *can*, *coſt*, *cup*, *clean*, *crab*. It ſounds ſoft, like *s*, before *e*, *i*, and *y*; as *cellar*, *circle*, *cynick*. *Ch* is ſounded like *tſh*, as *chance*, *check*, *chin*, *chop*, *churl*; but in words derived from the Greek or Latin, it is ſounded like *k*, as *chaos*, *choler*, *chymiſt*, *chyle*, *chord*. In words derived from the French it is ſounded like *ſh*, as *chaiſe*, *chevalier*, *machine*. In *choir* and *choiriſter*, it is ſounded like *qu*.

G has ſometimes a hard, and ſometimes a ſoft ſound. It has a hard ſound before *a*, *o*, *u*, *l*, *and r*; as *gaze*, *got*, *gun*, *globe*, *grain*. It is likewiſe hard at the end of words, as *lag*, *flag*, *leg*, *peg*. It is alſo hard before *i*, as *giddy*, *girdle*; except in *giant*, *gibbet*, *gibe*, *giblets*, *giles*, *gilliflower*, *gimcrack*, *gimp*, *gin*, *ginger*, *gingle*, *gipſey*, and a few other words. It is generally ſoft before *e*, as *gentle*, *generous*; except in *gear*, *geld*, *geeſe*, *gewgaw*. Before *n* it is mute, as *gnaſh*, *gnaw*, *feign*, *reign*. *Gh*, at the end of ſome words, is ſounded like *ff*, as *laugh*, *cough*, *tough*, *rough*, *enough*.

H, at the beginning of ſome words, is almoſt, if not entirely, mute, as *heir*, *herb*, *hour*, *honeſt*.

S in ſome words, is not ſounded, as *iſle*, *iſland*, *demeſne*, *viſcount*, *Carliſle*.

Ti before a vowel ſounds like *ſhi*, as *addition*, *multiplication*, *ſubſtraction*, *reduction*; except an *ſ* goes before it, and then it retains its natural ſound, as *beſtial*, *fuſtian*, &c. It likewiſe retains its natural ſound, when a conſonant follows it, as *tide, tile, tin*. It does the ſame before comparatives in *er*, and ſuperlatives in *eſt*, from adjectives ending in *y*, as *loftier, loftieſt*, from *lofty*; as alſo in the plural number of nouns, and the ſecond and third perſon of verbs ending in *ty*, as *beauties*, *counties*, to *empty*, thou *emptieſt*, he *emptieth*, or *emptied*.

As to the right ſpelling of words, I know of no method ſo good for acquiring that art, as by attending carefully to what we read; for books are always well ſpelled according to the orthography of the times. Some words indeed are doubtful, being ſpelled differently by different authors of equal authority; but thoſe are few: and in thoſe caſes every man has his option, becauſe he may plead his authority either way: but where there is but one right way of ſpelling a word, a man of the leaſt education ſhould be aſhamed not to know it.

However, as many perſons who can ſpell tolerably well, are ſometimes apt to commit blunders in ſpelling words, the ſame, or nearly the ſame in ſound, but different in ſignification, I ſhall here ſubjoin a catalogue of theſe words, in order to enable the reader to ſpell them right.

A CATALOGUE of WORDS, the ſame, or nearly the ſame in SOUND, but different in SIGNIFICATION.

A

ABEL, Cain's brother
A Bell, of metal
Able, powerful
Accidence, a book
Accidents, chances
Account, eſteem
Accompt, reckoning
Achor, a valley
Acre, of land
Advice, counſel
Adviſe, to counſel
Ale, malt liquor
Ail, trouble
All, every one
Awl, to bore holes
Ale-hoof, an herb
Aloof, at a diſtance
Allay, to give eaſe
Alloy, baſe metal
Alley, a narrow paſſage
Ally, a confederate
A Lye, a falſity
Allowed, granted
Aloud, to ſpeak ſo
Altar, for ſacrifice
Alter, to change
Amiſs, wrong

A Miſs, a concubine
Ant, a piſmire
Aunt, a father's ſiſter
A Peal, ringing
Appeal, to higher powers
A Peer, a Lord
Appear, to be ſeen
A Roſe, a flower
Aroſe, did riſe
Air, we breathe
Are, they be
Heir, to an eſtate
Arrant, notorious
Errand, a meſſage
Arras, Tapeſtry
Arrows, to ſhoot
Haraſs, to trouble
A ſcent, ſmell
Aſcent, going up
Aſſent, agreement
Aſſiſtance, Help
Aſſiſtants, Helpers
Augur, a Soothſayer
Augre, for Carpenters
Ax, to cut wood
Acts of parliament

B

Babel, the tower
Babble, to prate
Bacon, Hog's fleſh
Baken, in the oven
Beckon, to make a ſign
Beacon, to fix on a hill
Bail, a ſurety
Bale, of cloth
Bald, without hair
Bawl'd, cry'd out
Ball, a round ſubſtance
Bawl, to cry aloud
Barbara, a woman's name
Barbary, in Africa
Barberry, a fruit
Bare, naked
Bear, a beaſt
Bays, bay trees
Baize, cloth
Baſe, vile
Baſs, in muſic
Be, are
Bee, that makes honey
Beer, malt liquor
Bier, to carry the dead
Bel, an idol
Bell, to ring
Belly, part of the body
Belie, to ſpeak falſely
Berry, a ſmall fruit
Bury, to inter
Blew, did blow
Blue, a colour
Board, a plank
Boar'd, a hole
Boar, a beaſt
Bore, to make a hole
Boor, a country fellow
Bold, brave
Bowl'd, caſt as a bowl
Bolt, of the door
Boult, in the mill
Beau, a fop
Bow, to bend
Bough, of a tree
Boy, a lad
Buoy, of an anchor
Bread, to eat
Bred, brought up
Breeches, to wear
Breaches, broken places
Bruit, a report
Brute, a beaſt
Burrow, for coneys
Borough, a corporation
By, near

Buy, to purchaſe
Brews, he breweth
Bruiſe, a hurt
Brewis, of fat and bread
Buſs, a fiſhing veſſel
Buz, the noiſe of a fly

C

Caen, in Normandy
Cain, the murderer
Cane, to walk with
Calais, in France
Chalice, a cup
Call, by name
Cawl, of a periwig
Canon, a rule
Cannon, a great gun
Capital, chief
Capitol, a tower in Rome
Career, full ſpeed
Carrier, that carrieth
Cellar, for liquors
Seller, of goods
Cenſer, for incenſe
Cenſor, a reformer
Cenſure, judgment
Centaury, an herb
Century, an hundred years
Centry, a ſoldier on guard
Chair, to ſit in
Chare, a job of work
Choler, rage
Collar, for the neck, or of brawn
Ceiling, of a room
Sealing, with a ſeal
Cittern, an inſtrument
Citron, a fruit
Choir, of a cathedral
Quire, of paper
Clauſe, of a ſentence
Claws, of a beaſt or bird
Coat, a garment
Cot, a ſmall houſe
Comb, for the hair
Come, walk hither
Comet, a blazing ſtar
Commit, to do
Common, uſual
Commune, to converſe
Council, an aſſembly
Counſel, advice
Coarſe, not fine
Courſe, to be run
Currant, a fruit
Current, paſſable, or a ſtream
Courant, a meſſenger, or news-paper
Couſin, a relation
Cozen, to cheat
Cymbal, a muſical inſtrument
Symbol, a mark
Cypreſs, a tree
Cyprus, an iſland
Cruſe, a little veſſel
Cruiſe, by the ſea-coaſt
Cygnet, a young ſwan
Signet, a ſeal

D

Dane, of Denmark
Deign, to vouchſafe
Dam, to ſtop water
Damn, to condemn
Dear, of great value
Deer, in a park
Deceaſed, dead
Diſeaſed, ſick
Decent, becoming
Deſcent, going down

Diſſent, to diſagree
Deep, low in the earth
Diep, a town in France
Defer, to put off
Differ, to diſagree
Dew, a falling miſt
Due, owing
Do, to perform
Doe, a female deer
Dough, paſte of leaven
Don, a Spaniſh Lord
Done, acted
Dun, a colour
Dolphin, a fiſh
Dauphin, the French King's eldeſt ſon
Devices, inventions
Devizes, a town
Doer, that doth
Door, of a houſe
Dragon, a beaſt
Dragoon, a ſoldier
Draught, of drink
Drought, dryneſs

E

Ear, of the head
E'er, ever
Year, twelve months
Earth, the ground
Hearth, of a chimney
Eaſter, a feſtival
Eſther, a woman's name
Eaten, devoured
Eaton, a town's name
Eminent, famous
Imminent, over head
Enow, in number
Enough, in quantity
Enter, to go in
Inter, to bury
Envy, hatred
Envoy, a meſſenger
Exerciſe, labour
Exorciſe, to conjure
Extant, in being
Extent, breadth and length

F

Fain, deſirous
Feign, to diſſemble
Faint, weary
Feint, a pretence
Fair, beautiful, or a market
Fare, victuals, or a common hire
Feed, to eat
Fee'd, rewarded
File, of metal
Foil, to overcome
Fillip, with the finger
Philip, a man's name
Fir, wood
Fur, hair
Flower, of the field
Flour, meal
Floor, of a room
Follow, to come after
Fallow, ground untill'd
Flea, an inſect
Flee, to eſcape
Flue, of a chimney
Flew, did fly
Forth, abroad
Fourth, in number
Foul, dirty
Fowl, a bird
Francis, a man's name
Frances, a woman's name
Frays, quarrels

Fraiſe, a pancake with bacon
Frieze, a cloth
Freeze, with cold

G

Gall, of a beaſt
Gaul, France
Garden, of herbs
Guardian, an overſeer
Genteel, graceful
Gentile, Heathen
Gentle, mild
Geſture, carriage
Jeſter, a merry fellow
Gilt, with gold
Guilt, of ſin
Glutinous, ſticking
Gluttonous, greedy
Grate, for coals
Great, large
Grater, for nutmeg
Greater, larger
Groan, to ſigh
Grown, increaſed
Grot, a cave
Groat, four-pence

H

Hail, frozen drops of rain
Hale, healthy, to call
Hall, in a houſe
Hawl, to pull
Heel, of the foot,
Heal, to cure
He'll, he will
Hare, a beaſt
Hair, of the head
Harſh, ſevere
Haſh, minced meat
Haven, a harbour
Heaven, a place of happineſs
Hart, a beaſt
Heart, of the body
Herd, of cattle
Heard, did hear
Hard, not ſoft, difficult
Here, in this place
Hear, with the ears
Hie, make haſte
High, lofty
Hoy, a ſmall ſhip
Him, that man
Hymn, a ſpiritual ſong
Higher, taller
Hire, wages
His, of him
Hiſs, as a ſnake, to deride
Hoar, froſt
Whore, a lewd woman
Hole, hollowneſs
Whole, entire
Ho! lo! to call
Hallow, to make holy
Hollow, having a cavity
Holy, ſacred
Wholly, entirely
Holly, a tree
Home, one's houſe
Whom? what man?
Holm, a ſort of oak
Hoop, for a tub
Whoop, to cry out
Hue, colour
Hew, to cut
Hugh, a man's name

I *I*, my-

I

I, myſelf
Eye, to ſee with
Idle, lazy
Idol, an image
I'll, I will
Ile, of a church
Iſle, an iſland
Oil, of olive
Employ, work
Imply, to ſignify
In, within
Inn, for travellers
Incite, to ſtir up
Inſight, knowledge
Ingenious, of quick parts
Ingenuous, candid

K

Ketch, a ſhip
Catch, to lay hold of
Kill, to ſlay
Kiln, for lime
Kind, good-natured
Coin'd, at the Mint
Knave, a cheat
Nave, of a wheel
Knight, by honour
Night, darkneſs
Kennel, for dogs
Channel, for water

L

Lain, did lie
Lane, a narrow paſſage
Latin, the Roman tongue
Latten, tin
Lattice, of a window
Lettice, a woman's name
Lettuce, an herb
Leaſe, of a houſe
Leaſh, a ſtring, three
Lees, dregs of wine
Leaper, that leapeth
Leper, one leprous
Leſſen, to make leſs
Leſſon, to be read
Leaſt, ſmalleſt
Leſt, for fear
Lethargy, ſleepineſs
Liturgy, common prayer
Lier, in wait
Lyar, a teller of lies
Limb, a member
Limn, to paint
Line, length
Loin, of veal
Lo! behold
Low, humble
Loſe, to ſuffer loſs
Looſe, to let go

M

Made, finiſhed
Maid, a young woman
Main, chief
Mane, of a beaſt
Male, the He
Mail, armour
Manner, cuſtom
Manor, a lordſhip
Market, for traffic
Mark it, mind that
Marſh, watry ground
Maſh, for an horſe
Meſh, of a net
Martin, a man's name

Marten, a bird
Mead, a meadow
Mede, one of Media
Mean, baſe
Mien, carriage, aſpect
Meat, to eat
Meet, fit
Mete, to meaſure
Meſſage, an errand
Meſſuage, a houſe
Mews, for horſes
Muſe, to meditate
Mighty, powerful
Moiety, half
Mile, in length
Moil, to labour
Might, ſtrength
Mite, in cheeſe
Moat, a ditch
Mote, in the eye
Moan, to lament
Mown, cut down
More, in quantity
Mower, that mows
Moor, barren ground, a black

N

Naval, belonging to ſhips
Navel, of the belly
Nay, not
Neigh, as a horſe
Neither, none of the two
Nether, lower
New, not old
Knew, did know
Nice, curious
Noiſe, clamour
Not, denying
Knot, to tie
Note, a mark, or, of one's hand
Noſe, of the face
Knows, underſtands

O

Oar, of a boat
O'er, over
Ore, of metal
Of, belonging to
Off, at a diſtance
Oh! alas!
Owe, to be indebted
One, in number
Won, at play
Order, a rule
Ordure, dung
Our, of us
Hour, ſixty minutes

P

Palate, of the mouth
Pallet, a little bed
Pale, colour
Pail, a veſſel
Pall, a funeral cloth
Paul, a man's name
Paraſite, a flatterer
Parricide, a murderer
Parſon, of a pariſh
Perſon, ſomebody
Peal, of bells
Peel, of an onion, &c.
Pear, a fruit
Pair, a couple
Pare, to cut off
Pick, to chuſe

Pique, a quarrel
Pint, half a quart
Point, a ſtop
Place, of abode
Plaice, a fiſh
Plait, the hair
Plate, metal
Pleaſe, to content
Pleas, excuſe
Pole, a long ſtick
Poll, to cut the hair
Pore, of the ſkin
Poor, beggarly
Poſy, of flowers
Poeſy, poetry
Pour, to empty
Power, might
Practice, exerciſe
Practiſe, to exerciſe
Pray, to entreat
Prey, a booty
Preſence, being here
Preſents, gifts
Princes, king's ſons
Princeſs, a king's daughter
Principal, chief
Principle, the firſt rule
Profit, advantage
Prophet, a foreteller
Prophecy, a foretelling
Propheſy, to foretell

Q

Quire, of paper
Choir, of ſingers
Queen, a king's wife
Quean, a harlot

R

Rack, to torment
Wreck, of a ſhip
Rain, water
Reign, of a king
Rein, of a bridle
Raiſe, lift up
Rays, ſun beams
Raiſin, a fruit
Reaſon, argument
Race, to run
Raſe, to demoliſh
Red, a colour
Rid, to diſencumber
Read, a book
Reed, a ſhrub
Relick, a remainder
Relict, a widow
Reſt, quiet
Wreſt, to pervert
Rhyme, in verſe
Rime, a hoar froſt
Rice, Indian corn
Riſe, advancement
Rye, corn
Wry, crooked
Ring, the bells
Wring, the hands
Rite, ceremony
Right, juſt
Wright, an artificer in wood
Write, with a pen
Rode, did ride
Road, the highway
Row'd, did row
Roe, a deer, eggs of a fiſh
Row, a boat, rank or file
Rome, a city
Room, part of a houſe
Rote, by heart
Wrote, did write
Wrought, did work
Rough, not ſmooth
Ruff, a band
Roof, top of a houſe

S

Sail,	of a ſhip
Sale,	of goods
Satiety,	fulneſs
Society,	company
Saviour,	that ſaveth
Savour,	ſmell, taſte
Scene,	of the ſtage
Seen,	beheld
Sea,	ocean
See,	with the eyes
Seas,	great waters
Seize,	to lay hold of
Ceaſe,	to leave off
Sent,	ordered away
Scent,	a ſmell
Ship,	for ſailing
Sheep,	a beaſt
Shore,	the ſea-coaſt
Sewer,	a common drain
Shown,	did ſhow
Shone,	did ſhine
Sign,	a token
Sine,	in geometry
Site,	ſituation
Cite,	to ſummon
Sight,	view
Sink,	to go down
Cinque,	five
Slight,	to deſpiſe
Sleight,	of hand
Sloe,	a ſour fruit
Slow,	tardy
Slough,	a puddle
Sole,	of a ſhoe
Soul,	of a man
So,	thus
Sow,	ſeed
Some,	a part
Sum,	of money
Son,	a man-child
Sun,	in the firmament
Soon,	quickly
Swoon,	to faint
Sore,	an ulcer
Soar,	to mount upwarh
Soar'd,	did ſoar
Sword,	a weapon
Stare,	to look earneſtly
Stair,	a ſtep
Stile,	to get over
Style,	of writing
Straight,	not crooked
Strait,	narrow
Succour,	help
Sucker,	a young twig
Sue,	to proſecute at law
Sew,	with a needle

T

Tail,	the end
Tale,	a ſtory
Tame,	not wild
Thame,	a town
Tare,	weight allowed
Tear,	to rend in pieces
Than,	in compariſon
Then,	at that time
There,	in that place
Their,	of them
Throne,	a ſeat of ſtate
Thrown,	caſt
Tie,	to make faſt
Toy,	a play thing
Tide,	flux of the ſea
Ty'd,	made faſt
Tile,	of a houſe
Toil,	to take pains
Time,	when
Thyme,	an herb
Team,	of horſes
Teem,	with child

To, unto
Toe, of the foot
Too, likewiſe
Tow, to draw along
Two, couple
Told, as a tale
Toll'd, as a bell
Tongs, for the fire
Tongues, languages
Tour, a journey
Tower, of defence

V

Vacation, ceaſing
Vocation, a calling
Vail, to let fall
Vale, a valley
Veil, a covering
Vain, fruitleſs
Vane, a weathercock
Vein, of the body
Valley, a dale
Value, worth
Volley, of ſhot
Vaſſal, a ſlave
Veſſel, for uſe
Vial, or *phial,* a glaſs
Viol, a fiddle
Vice, ill habit
Vice, for a workman
Voice, a ſound

U

Ure, uſe
Ewer, a baſon
Your, of you
Uſe, to be wont
Ewes, ſheep

W

Wade, in the water
Weigh'd, in the balance
Wail, to mourn
Whale, a ſea-fiſh
Wane, decreaſe
Wain, a waggon
Wean, a child
Wait, to ſtay for
Weight, heavineſs
Ware, merchandiſe
Wear, cloths
Where, in what place
Were, they were
Waſte, to ſpend
Waiſt, the middle
Way, to walk in
Weigh, to poize
Wey, 40 buſhels
Whey, of milk
Weal, good
Wheal, a pimple
Wheel, of a coach
Wield, to manage
Wild, untamed
Wen, a ſwelling
When, at what time
What, which
Wat, Walter a man's name
While, in the mean time
Wile a trick
White, a colour
Wight, an iſland
Whore, a lewd woman
Hoar, froſt
Witch, a ſorcereſs
Which, who or what
Wiſt, knew
Whiſt, ſilence
Wood, of trees
Wou'd, was willing

Y.

Yarn,	woollen	*Yea,*	yes
Yearn,	to pity	*Yew,*	a tree
Earn,	to get	*Ewe,*	a female ſheep
Ye,	yourſelves	*You,*	yourſelf.

ETYMOLOGY.

Etymology teaches the derivation of one word from another, and the different methods in which the ſenſe of the ſame word is varied; as *tree, trees*; *high, higher*; *I walk, I walked.* In the Engliſh language there are nine kinds of words, or, as they are commonly called, parts of ſpeech. Theſe are the Article, Noun, Pronoun, Verb, Participle, Adverb, Prepoſition, Interjection, and Conjunction.

Article. The articles are two in number, viz. *a* or *an,* and *the.* *A* or *an* ſhews, that one only of a kind is meant, but no one in particular; and hence it is called the *indefinite article*; as *a ſwift horſe,* that is one of the horſes that are ſwift, without mentioning any particular horſe. *A* is uſed before words beginning with a conſonant, as *a father*: and *an* before words beginning with a vowel, as *an uncle*; or an *h* mute, as *an heir.* *The* confines the ſenſe to one or more of a kind. *This is the cow that I bought*; *theſe are the ſheep that I ſold:* that is, this particular cow, and theſe particular ſheep.

Nouns. Nouns are of two kinds, either ſubſtantive or adjective. A ſubſtantive noun will make ſenſe by itſelf, as *a man, a woman.* An adjective noun will not make ſenſe by itſelf, as *ſtrong, handſome*; unleſs it be joined with a ſubſtantive, and then it will make ſenſe, as *a ſtrong man, a handſome woman.*

Substantives. As to ſubſtantive nouns, there are three things to be obſerved, namely, their gender, their number, and their caſe.

Gender. There are two genders, the maſculine and the feminine; the firſt denoting males, the ſecond denoting females; and there is likewiſe a third gender, called the neuter gender, denoting ſuch beings as are either male or female, as *a child, a ſparrow.* The Engliſh ſometimes diſtinguiſh the different genders, or ſexes, by different words, as

Male.	Female.	Male.	Female.
Bachelor,	*Maid, Virgin.*	*King,*	*Queen.*
Boar,	*Sow.*	*Lad,*	*Laſs.*
Boy,	*Girl.*	*Lord,*	*Lady.*
Bridegroom,	*Bride.*	*Man,*	*Woman.*
Brother	*Siſter.*	*Maſter,*	*Miſtreſs.*
Buck,	*Doe.*	*Miller,*	*Spawner.*
Bull,	*Cow.*	*Nephew,*	*Niece.*
Bullock,	*Heifer.*	*Ram,*	*Ewe.*
Cock,	*Hen.*	*Sloven,*	*Slut.*
Dog,	*Bitch.*	*Son,*	*Daughter*
Drake,	*Duck.*	*Stag,*	*Hind.*
Father,	*Mother.*	*Uncle,*	*Aunt.*
Friar,	*Nun.*	*Widower,*	*Widow.*
Gander,	*Gooſe.*	*Wizard,*	*Witch.*
Horſe,	*Mare.*	*Whore-monger,*	*Whore or Strumpet.*
Huſband,	*Wife.*		

To nouns of the neuter gender we ſometimes add an adjective, to diſtinguiſh the difference of ſex, as *a male child, a female child.* Sometimes a ſubſtantive, as *a man-ſervant, a maid ſervant.*

The feminine gender is ſometimes made by changing the termination of the maſculine into *eſs,* as

Male.	Female.	Male.	Female.
Abbot,	*Abbeſs.*	*Lion,*	*Lioneſs.*
Actor,	*Actreſs.*	*Marquis,*	*Marchioneſs.*
Ambaſſador,	*Ambaſſadreſs.*	*Patron,*	*Patroneſs.*
Baron,	*Baroneſs.*	*Prince,*	*Princeſs.*
Count,	*Counteſs*	*Prior,*	*Prioreſs.*
Deacon,	*Deaconeſs.*	*Poet,*	*Poeteſs.*
Duke,	*Ducheſs.*	*Prophet,*	*Propheteſs.*
Elector,	*Electreſs.*	*Shepherd,*	*Shepherdeſs.*
Emperor,	*Empreſs.*	*Tutor,*	*Tutoreſs.*
Governor,	*Governeſs.*	*Viſcount,*	*Viſcounteſs.*
Heir,	*Heireſs.*		
Hunter,	*Huntreſs.*		
Jew,	*Jeweſs.*		

Some nouns make their feminine in *ix*; as *Executor*, *Executrix*. *He* always implies the maſculine gender; *She*, the feminine; and *it*, either the maſculine or feminine, that is, the neuter.

NUMBER. There are two numbers, the ſingular and plural. The plural, for the moſt part, is made by adding *s* to the ſingular, as *father*, *fathers*; *mother*, *mothers*. But if the ſingular ends in *ch*, *ſh*, *ſs*, or *x*, then *es* muſt be added, as *ditch*, *ditches*; *bruſh*, *bruſhes*; *witneſs*, *witneſſes*; *box*, *boxes*. Nouns ending in *f* or *fe*, in the ſingular, make their plural in *ves*, as *ſheaf*, *ſheaves*; *wife*, *wives*: though ſeveral that end in *f* or *fe*, form their plural in the uſual manner, only by adding *s*, as *hoof*, *hoofs*; *fife*, *fifes*: as alſo do moſt nouns ending in *ff*, as *cliff*, *cliffs*; *cuff*, *cuffs*; except *ſtaff*, which makes *ſtaves*. Nouns ending in *y* form their plural in *ies*, as *beauty*, *beauties*; *berry*, *berries*: unleſs the *y* in the ſingular makes part of a diphthong, that is, unleſs it is ſounded jointly with the preceding vowel, for then *y* is retained, and the plural is formed only by adding *s*, as *day*, *days*; *way*, *ways*. Some nouns have *en* in the plural, as *man*, *men*; *woman*, *women*. Some have *ce* or *ſe*, as *mouſe*, *mice*; *gooſe*, *geeſe*. Some nouns are the ſame both in the ſingular and plural, as *ſheep*, *deer*; for we can ſay *one ſheep*, or a *thouſand ſheep*; *one deer*, or a *thouſand deer*. Some nouns have no ſingular, as *aſhes*, *bellows*, *ſnuffers*, &c. And others have no plural, as the proper names of men, women, cities, rivers, &c. as *Matthew*, *Mary*, *Mancheſter*, the *Severn*; except when there are ſeveral great men of the ſame name, as the *Cæſars*, the *Edwards*, the *Henrys*. The caſe is the ſame with the names of virtues and vices, as *frugality*, *prodigality*; of metals, as *gold*, *ſilver*; of herbs, as *mint*, *ſage*; and of corn and pulſe, as *wheat*, *barley*; except *oats*, *tares*, *peas*, *beans*.

CASE. There are only two caſes in the Engliſh language, the nominative and the genitive. The nominative is that, in which a thing is ſimply expreſſed, as *a tree*, *a river*. The genitive is that which implies property or poſſeſſion; and hence it is ſometimes called the poſſeſſive caſe. It is formed by adding *s*, with an apoſtrophe before it, to the nominative caſe, as *the tree's height*, *the river's depth*. Some people imagine that this *s* with the apoſtrophe, is only a contraction of *his*; and hence inſtead of *John's houſe*, they frequently write *John his houſe.* But this is a miſtake; for if it were right, we might with the ſame propriety, inſtead of *Nancy's book*, write *Nancy his book*, which would be downright nonſenſe. The genitive likewiſe is ſometimes formed by putting the particle *of* before it, as *the length of the day*, *the ſhortneſs of the night.* The Greek, Latin, and ſome other languages, have four other caſes, viz. the dative, the accuſative, the vocative, and the ablative; but the want of theſe in Engliſh is ſupplied by the prepoſitions *to*, *for*, *with*, *from*, *by*, &c.

ADJECTIVES. Adjectives admit of no variation in gender, number, or caſe, being joined to ſubſtantives of all genders, of both numbers, and in all caſes; as *a good man*, *a good woman*, *a good thing*; *of a good man*, *of a good woman*, *of a good thing*; *good men*, *good women*, *good things*; *of good men*, *of good women*, *of good things.* The only change they undergo is in the degrees of compariſon. There are three degrees of compariſon, the poſitive, the comparative, and the ſuperlative. The poſitive is that in which the quality is ſimply expreſſed, as *long*, *broad.* The comparative is that in which the quality is ſomewhat increaſed, as *longer*, *broader.* The ſuperlative is that in which the quality is raiſed to the higheſt degree of which it is capable, as *longeſt*, *broadeſt.* The comparative is formed by adding *r* or *er* to the poſitive, as *white*, *whiter*; *black*, *blacker.* The ſuperlative is formed by adding *ſt* or *eſt* to the poſitive, as *white*, *whiteſt*; *black*, *blackeſt.* Adjectives of two or more ſyllables are commonly compared by *more* and *moſt*, as *humane*, *more humane*, *moſt humane.* The following are irregularly compared.

Poſitive.	Comparative.	Superlative.
Good,	*Better*,	*Beſt.*
Bad,	*Worſe*,	*Worſt.*
Little,	*Leſs*,	*Leaſt.*
Much or Many,	*More*,	*Moſt.*
Near,	*Nearer*,	*Neareſt or Next.*
Late,	*Later or Latter*,	*Lateſt or Laſt.*

Pronouns. Pronouns are words that ſupply the place of nouns, and are uſed to prevent the too frequent repetition of them. They are of four kinds, perſonal, poſſeſſive, relative, and demonſtrative. Some of them have a caſe peculiar to themſelves; it is called the oblique or objective caſe, and is uſed after moſt verbs and prepoſitions.

The perſonal pronouns are *I, thou, he, ſhe, it,* with their plurals; and they are thus declined:

	Singular.	Plural.
Nominative	*I.*	*We.*
Oblique caſe	*Me.*	*Us.*
Nominative	*Thou.*	*Ye.*
Oblique caſe	*Thee.*	*You.*
Nominative	*He. She.*	*They.*
Oblique caſe	*Him. Her.*	*Them.*
Nominative	*It.*	*They.*
Oblique caſe	*It.*	*Them.*
Genitive	*Its.*	

Moſt writers ſay *you are,* and *you were,* for *thou art,* and *thou waſt.*

The poſſeſſive pronouns are *my, our, thy, your, his, her, their*; and they are no otherwiſe declinable except that, when they are ſeparated from their ſubſtantives by a verb, *my* becomes *mine*; *thy, thine*; *our, ours*; *your, yours*; *her, hers*; *their, theirs:* as *this is my pen*; *this pen is mine: that is our paper*; *that paper is ours: this is your cart*; *this cart is yours: this is her glove*; *this glove is hers: that is their garden*; *that garden is theirs. His* is never changed: as *this is* his *cane*; *this cane is* his. *Mine* and *thine* are ſometimes uſed for *my* and *thy*, before words that begin with a vowel, as *mine* eye, *mine* ear.

Relative pronouns are ſo called becauſe they relate to ſome ſubſtantive going before, which is therefore called the antecedent. They are four in number, viz. *who, which, what,* and *whether. Who* is declined thus

Singular and Plural.	
Nominative	*Who*
Genitive	*Whoſe*
Oblique	*Whom*

Whoſe likewiſe, eſpecially among the poets, is ſometimes uſed as the genitive of *which*, as *the river* whoſe *bottom was ſandy*, inſtead of, *the river the bottom* of which *was ſandy*. *What* and *whether* are not declined. *Who* properly relates to perſons; *what*, to things.

The demonſtrative pronouns are *This*, *that*, *other*, and *the ſame*. *This* makes *theſe* in the plural, *that* makes *thoſe*, and *other* makes *others*. *Other*, indeed, is either ſingular or plural; for we ſay *the one ſide or the other*: and *other men*, *other women*. *Others* is never uſed but when it refers to a preceding ſubſtantive; as *ſome of the cattle were fat*; others *were lean*.

VERBS. A verb is a word that ſignifies to be, to do, or to ſuffer; as *I live*, *I command*, *I am commanded*. There are three kinds of verbs; active, paſſive, and neuter. An active verb denotes an action, as *I blame him*; a paſſive verb denotes a paſſion, as *I am blamed by him*; and a neuter verb denotes neither an action nor a paſſion, but rather ſomething between both, as *I am*, *I come*, *I go*. A verb has three perſons in the ſingular number, and three in the plural. The firſt perſon ſingular is *I*, the ſecond is *thou* or *you*, the third *he*, *ſhe*, or *it*; the firſt perſon plural is *we*, the ſecond *ye* or *you*, and the third *they*. We muſt always take care to make the verb agree with its perſon; or, as it is commonly called, its nominative; as *I know*, *thou knoweſt or doſt know*, *he knows*; *we know*, *ye or you know*, *they know*. We muſt never ſay *I knows*, as many ignorant people do. Verbs are ſaid to be either regular or irregular. Regular verbs form their ſecond tenſe, or, as it is uſually called, their preter-imperfect tenſe, and their participle paſſive, in *ed*, as *ploughed*, *ſowed*, *planted*. Irregular verbs either ſimply change the *ed* into *t*, as *mix*, *mixt* for *mixed*; or they likewiſe drop one of the two conſonants, as *poſſeſs*, *poſſeſt*; or they alſo change a double vowel, or diphthong, into a ſingle vowel, as *feel*, *felt*, *weep*, *wept*: or, finally, they form their preter-imperfect tenſe and participle paſſive in ſuch a variety of different ways, that they cannot be reduced to any certain rules. I ſhall therefore preſent the reader with a catalogue of them, informing him, however, at the ſame time, that ſome of theſe verbs are conjugated regularly, as well as irregularly; and where that is the caſe, an aſteriſk is ſubjoined to them.

Preſent Tenſe,	Preter-imperfect Tenſe,	Participle Paſſive.
Abide,	Abode,	Abode.
Am,	Was,	Been.
Ariſe,	Aroſe,	Ariſen.
Awake,	Awoke *,	Awoke*.
Bear,	Bare, Bore,	Born.
Beat,	Beat,	Beaten.
Begin,	Began,	Begun.
Bend,	Bent,	Bent.
Unbend,	Unbent,	Unbent.
Bereave,	Bereft*,	Bereft*.
Beſeech,	Beſought*,	Beſought*.
Bid,	Bade,	Bidden.
Bind,	Bound,	Bound.
Bite,	Bit,	Bitten.
Bleed	Bled,	Bled.
Blow,	Blew,	Blown.
Break,	Brake, Broke,	Broke, Broken.
Breed,	Bred,	Bred.
Bring,	Brought,	Brought.
Build,	Built,	Built.
Burſt,	Burſt,	Burſt, Burſten.
Buy,	Bought,	Bought.
Can,	Could,	———
Caſt,	Caſt,	Caſt.
Catch,	Caught*,	Caught*.
Chide,	Chid,	Chidden.
Chooſe, Chuſe,	Choſe,	Choſen.
Cleave,	Clave, Clove*,	Cloven.
Cling,	Clang, Clung,	Clung.
Clothe,	Clad*,	Clad*.
Come,	Came,	Come.
Coſt,	Coſt,	Coſt.
Crow,	Crew,	Crowed.
Cut,	Cut,	Cut.
Dare,	Durſt*,	Dared.
Die,	Died,	Dead.
Dig,	Dug*,	Dug*.
Draw,	Drew,	Drawn.

Drink,

Preſent Tenſe,	Preter-imperfect Tenſe,	Participle Paſſive.
Drink,	Drank,	Drunk, Drunken.
Drive,	Drove,	Driven.
Eat,	Ate,	Eaten.
Fall,	Fell,	Fallen.
Feed,	Fed,	Fed.
Fight,	Fought,	Fought.
Find,	Found,	Found.
Flee,	Fled,	Fled.
Fling,	Flung,	Flung.
Fly,	Flew,	Flown.
Forſake,	Forſook,	Forſaken.
Freeze,	Froze,	Frozen.
Get,	Gat, Got,	Got, Gotten.
Give,	Gave,	Given.
Go,	Went,	Gone.
Grind,	Ground,	Ground.
Grow,	Grew,	Grown.
Hang,	Hung*,	Hung*.
Have,	Had,	———
Hear,	Heard,	Heard.
Hew,	Hewed,	Hewn*.
Hide,	Hid,	Hidden.
Hit,	Hit,	Hit.
Hold,	Held,	Holden, Held.
Hurt,	Hurt,	Hurt.
Knit,	Knitted,	Knitted, Knit.
Know,	Knew,	Known.
Lay,	Laid,	Laid.
Lead,	Led,	Led.
Leave,	Left,	Left.
Lend,	Lent,	Lent.
Let,	Let,	Let.
Lie,	Lay,	Lain, Lien.
Load,	Loaded,	Loaden, Laden*.
Loſe,	Loſt,	Loſt.

Preſent Tenſe,	Preter-imperfect Tenſe,	Participle Paſſive.
Make,	Made,	Made.
May,	Might,	———
Meet,	Met,	Met,
Mow,	Mowed,	Mown*.
Muſt,	———	———
Ought,	Ought,	———
Pay,	Paid,	Paid.
Put,	Put,	Put.
———	Quoth he,	———
Read,	Read,	Read.
Rend,	Rent,	Rent.
Rid,	Rid,	Rid.
Ride,	Rode,	Ridden.
Ring,	Rang, Rung,	Rung.
Riſe,	Roſe,	Riſen.
Rive,	Rived,	Riven.
Run,	Ran,	Run.
Say,	Said,	Said.
Saw,	Sawed,	Sawn*.
See,	Saw,	Seen.
Seek,	Sought,	Sought.
Seethe,	Seethed,	Sodden.
Sell,	Sold,	Sold.
Send,	Sent,	Sent.
Set,	Set,	Set.
Shake,	Shook,	Shaken.
Shall,	Should	———
Shave,	Shaved,	Shaven*.
Shear,	Sheared, Shore,	Shorn.
Shed,	Shed,	Shed.
Shine,	Shone*,	Shone*.
Shoe,	Shod,	Shod.
Shoot,	Shot,	Shot.
Show,	Showed,	Shown*.
Shrink,	Shrank, Shrunk,	Shrunk.
Shut,	Shut,	Shut.
Sing,	Sang, Sung,	Sung.

Sink,

Preſent Tenſe,	Preter-imperfect Tenſe,	Participle Paſſive,
Sink,	Sank, Sunk,	Sunk.
Sit,	Sat,	Sat, Sitten.
Slay,	Slew,	Slain.
Slide,	Slid*,	Slidden.
Slink,	Slunk,	Slunk.
Sling,	Slang, Slung,	Slung.
Slit,	Slit*,	Slit.
Smite,	Smote,	Smitten.
Snow,	Snowed,	Snown*.
Sow,	Sowed,	Sown*.
Speak,	Spake, Spoke,	Spoken.
Speed,	Sped,	Sped.
Spend,	Spent,	Spent.
Spin,	Span, Spun,	Spun.
Spit,	Spat,	Spitten.
Split,	Split,	Split*.
Spread,	Spread,	Spread.
Spring,	Sprang, Sprung,	Sprung.
Stand,	Stood,	Stood.
Steal,	Stole,	Stolen, Stoln.
Stick,	Stuck,	Stuck.
Sting,	Stung,	Stung.
Stink,	Stank, Stunk,	Stunk.
Stride,	Strode,	Stridden.
Strike,	Struck,	Struck, Strucken, Stricken.
String,	Strung,	Strung.
Strive,	Strove*,	Striven.
Strow,	Strowed,	Strown.
Swear,	Swore, Sware,	Sworn.
Sweat,	Sweat, Swet*,	Sweat, Sweaten.
Swell,	Swelled,	Swollen.
Swim,	Swam, Swum,	Swum.
Swing,	Swung,	Swung.
Take,	Took,	Taken.
Teach,	Taught,	Taught.
Tear,	Tore, Tare,	Torn.
Tell,	Told,	Told.
Think,	Thought,	Thought.
Thrive,	Throve,	'Thriven.

Preſent Tenſe,	Preter-imperfect Tenſe,	Participle Paſſive.
Throw,	Threw,	Thrown.
Thruſt,	Thruſt,	Thruſt.
Tread,	Trode,	Trodden.
Trow,	———	———
Wear,	Wore,	Worn.
Weave,	Wove*,	Woven*.
Wet,	Wet,	Wet.
Will,	Would,	———
Win,	Wan, Won,	Won.
Wind,	Wound,	Wound*.
Wis,	Wiſt,	———
Wit, Wot,	Wot,	———
Work,	Wrought*,	Wrought*.
Wring,	Wrung*,	Wrung*.
Write,	Wrote, Writ,	Written, Writ, Wrote.

My deſign in giving this catalogue is to guard the reader againſt the uſe of improper words, and to prevent his ſaying (as many ignorant people do) I *ſee'd* for I *ſaw*, I *knowed* for I *knew*, I *throwed* for I *threw*, I *drawed* for I *drew*, it *blowed* for it *blew*, &c.

PARTICIPLE. A participle is a word derived from a verb, or more properly it is a certain form of a verb, which partakes of the nature of an adjective, as *ſucking*, *roaſted*. It even ſometimes ſupplies the place of an adjective, as *a ſucking pig*, *a roaſted fowl*. There are two participles, the active and the paſſive. The active is formed by adding *ing* to the firſt perſon of the preſent tenſe of the verb, and ſtriking off *e*, if the verb end in that letter; as *plant*, *planting*; *prune*, *pruning*. The paſſive is formed by adding *d* to the preſent tenſe of the verb, if it end in *e*; or *ed*, if it end in any other letter; as *approve*, *approved*; *condemn*, *condemned*.

ADVERBS. Adverbs, as well as prepoſitions, interjections and conjunctions, are ſometimes called particles; that is, they are certain little words that never change their termination. They are called *Adverbs*, becauſe they are commonly *added to verbs*, and ſerve to expreſs the manner and other circumſtances of an action; as *He ſpeaks* boldly, *She dreſſes* genteely, *He will come* to-day, *I will go* to-morrow.

Prepositions. A prepoſition is a particle that expreſſes the relation which one word has to another, and performs in Engliſh what is done in Latin by caſes, or the different terminations of nouns. The principal prepoſitions are thoſe that follow: *above, about, after, againſt, among, amongſt, at, before, behind, below, beneath, beſide, beſides, between, beyond, by, for, from, in, into, of, off, out of, on, upon, over, through, till, until, to, unto, toward, towards, under, up, with, within, without.*

Interjections. Interjections are certain little words, that are thrown in between the parts of a ſentence, to expreſs ſome ſudden emotion or paſſion of the mind; as *oh! alas! hiſt! huſh!*

Conjunctions. Conjunctions are words that join together ſentences, and ſhew their dependence upon each other; as *the cows* and *the horſes are both foddered:* here *and* is a conjunction. Neither *the apples* nor *the pears are ripe:* here *neither* and *nor* are conjunctions.

SYNTAX or CONSTRUCTION.

The Engliſh language is very ſimple in its conſtruction, and a few rules are ſufficient for the purpoſe. A verb muſt agree with its nominative, in number and perſon. For inſtance, we muſt ſay, *I love, I know*; and not *I loves, I knows*, as many illiterate people do. An active verb governs a noun, or rather a pronoun, in the oblique caſe (for it is pronouns only that have an oblique caſe) as, *He ſent* me. *She brought* us. *He taught* thee *or* you. *He loves* her. *She hates* him. *They beat* them. If a nominative comes between the relative and the verb, the relative is put in the oblique caſe; as *the man* whom *I diſcharged*; *the woman* whom *I hired.* Except when a queſtion is aſked, and then it is commonly put in the nominative caſe, though not very grammatically; as Who *did you ſee?* Who *did you meet?*

The prepoſitions likewiſe govern the oblique caſe; as *ſend it to* me. *Bring it to* us. *Take it from* him. *Give it to* her. *Go with* them. *The man* whom *I got it from.* But if a queſtion is aſked, the relative is commonly put in the nominative; as Who *did you get it from?* Sometimes the prepoſition is underſtood; as *give me ſome bread*; that is, *give ſome bread to me*: *hand me a knife*; that is, *hand a knife* to *me*. Conjunctions couple like caſes together; as *between* you *and* me; not *between* you *and* I: for *you* is properly in the oblique caſe, though it is ſometimes uſed in the nominative for *thoſe* or *ye*. Adverbs govern no caſe. Some interjections take the oblique caſe after them; as *Ah* me! *Wo is* me!

PROSODY.

Proſody is that part of grammar, which teaches the true pronunciation of words, and the rules of verſification. As to the rules of verſification, we have nothing to do with them at preſent; and with regard to the true pronunciation of words, a few obſervations will ſuffice. By the true pronunciation of words is meant the giving to every letter its proper ſound, and to every ſyllable its proper quantity or accent. The ſounds of the ſeveral letters have been already explained in the beginning of this chapter; and as to the quantity or accent, though they are in ſome meaſure different, they may here be conſidered as the ſame. That ſyllable of a word is ſaid to be accented, upon which the chief ſtreſs of the voice is laid. Moſt Engliſh words, of two or three ſyllables, have the accent on the firſt ſyllable, though with ſome exceptions. For inſtance, words of three ſyllables, ending in *ator*, have the accent on the middle ſyllable, as *ſpectátor*; and words of three ſyllables, derived from the Latin or French, have the accent on the laſt, as *introdúce*, *maſqueráde*. Some polyſyllables, or words of more than three ſyllables, ſeem to have two accents, as *mágnanĭmity*; and ſome three, as *incomprehénſĭbĭlity*. The beſt way of learning the true accent of words is by reading the works of the moſt elegant poets, where every word has, or at leaſt ought to have, its proper quantity or accent.

PUNCTUATION.

Punctuation is the art of diſtinguiſhing, by certain marks, the ſeveral ſtops or pauſes in a ſentence. The principal marks uſed for this purpoſe are:

The *Comma*	expreſſed thus	,
The *Semicolon*		;
The *Colon*		:
The *Period* or *full Stop*		.

The *Comma* requires us to ſtop as long as we can count *one*; the *Semicolon*, as long as we can count *two*; the *Colon* as long as we can count *three*; and the *Period* or *full Stop*, as long as we can count *four*.

There are three other points, namely

The point of Interrogation	marked thus	?
The point of Admiration		!
The Parentheſis		()

The point of interrogation is placed after a queſtion; the point of admiration, after a word expreſſing wonder or ſurpriſe; and the parentheſis ſerves to incloſe a ſhort ſentence, which is inſerted in the body of a larger one, and which though not abſolutely neceſſary to complete the ſenſe, helps, nevertheleſs, to render it much clearer. Examples of theſe points are to be met with in almoſt every book you read.

There are likewiſe a variety of other marks, ſome of which do not ſo frequently occur. Theſe are

The *Apoſtrophe* (') which is placed at the head of letters, to ſhew that ſome letter or letters are left out, as *mov'd* for *moved*, *ſow'd* for *ſowed*.

An *Aſteriſk* (*) refers to ſome note in the margin or at the bottom of the page. Several of them joined together ſignify that there is ſomething wanting or omitted in the paſſage, thus***.

A *Caret* (‸) ſhews, that ſome letter, ſyllable, or word is left out by miſtake; and this mark is put under the line exactly in the place where what is omitted ſhould come in.

A *Circumflex* (^) which has nearly the ſame ſhape as a *caret*, is placed over ſome vowel of a word, to ſhew that the ſyllable is loug, as *Euphrâtes*.

A *Dialyſis* (¨) placed over the laſt of two vowels, ſhews that they do not make a diphthong, but are to be pronounced ſeparately, as *Staniſlaüs*.

A *Hyphen* (-) placed at the end of a line, ſhews, that the laſt word is not finiſhed; but that part of it begins the next line. It alſo ſerves to join compound words together, as a *drill-plough*, a *hand-ſaw*.

An *Index* (☞) or fore-finger pointing, ſhews, that the paſſage, to which it is prefixed, contains ſomething remarkable.

An *Obeliſk* (†) or dagger, anſwers the ſame end as an *Aſteriſk*; that is, it points to ſome note in the margin, or at the bottom of the page. Several other marks are uſed for this purpoſe, ſuch as parallel lines (‖); a double *obeliſk*, or obeliſks formed in different manners (†‡‡); figures (1. 2. 3. &c.); or letters (a. b. c. &c.)

A *Paragraph* (¶) is ſeldom uſed but in the bible, and denotes the beginning of a new ſubject.

Crotchets or *Brackets* ([]) ſerve nearly the ſame purpoſe as a *Parentheſis*.

A *Quotation* (“) is put at the beginning of any paſſage that is cited out of another author. The *End of a Quotation* (”) is put at the concluſion of the paſſage cited, and ſhews that it is completely finiſhed.

A *Section* (§) ſerves to divide books or chapters into ſmaller parts. It is likewiſe ſometimes uſed to point to a note in the margin, or at the bottom of the page.

Braces } are uſed to join ſeveral lines together, eſpecially in poetry; as

Waller was ſmooth; but Dryden tought to join }
The varying verſe, the full-reſounding line, }
The long majeſtic march, and energy divine. }

ABBREVIATION.

Abbreviation is a method of expreſſing certain words by ſetting down only one or more of their initial letters, and putting a full ſtop after ſuch letter or letters. The principal abbreviations are thoſe that follow.

A. Anſwer.
A B. or *B. A*. Bachelor of arts.
Abp. Archbiſhop.
A. D. *Anno Domini*, in the year of our Lord.
A. M. *Artium Magiſter*, maſter of arts; or *Anno Mundi*, in the year of the world.
Ana. A phyſical term ſignifying the like quantity.
Ap. Apoſtle, April.
A. R. *Anna Regina*, Queen Anne; or *Anno Regni*, in the year of the reign.
Aſt. P. G. C. Profeſſor of Aſtronomy in Greſham College.
Aug. Auguſt.
Bart. Baronet.
B. D. Bachelor of Divinity.
Bp. Biſhop.
B. V. Bleſſed Virgin.
C. C. C. Corpus Chriſti College.
Chap. Chapter.
Cl. Clerk, Clergyman.
Cr. Creditor.
C. R. *Carolus Rex*, King Charles.
C. S. *Cuſtos Sigilli*, Keeper of the Seal.
C. P. S. *Cuſtos privati Sigilli*, Keeper of the privy Seal.
D. Duke, Dutchy, Dutcheſs, &c.
D. *Denarius*, a penny.
D. D. Doctor of Divinity.
Dr. Doctor or Debtor.
Dec. or 10*ber*, December.
Deut. Deuteronomy.
D. Dit. *Ditto*, the ſame.
E. Earl, Eaſt.
E. G. or *Ex. Gr*. *Exempli gratia*, for example.
Feb. February.
F. R. S. Fellow of the Royal Society.
Gen. Geneſis.
G. R. *Georgius Rex*, King George; *Gul. Rex*, King William.
H. S. *Hic Situs*, Here lies.
Ibid. *Ibidem*, In the ſame place.
Id. *Idem*, the ſame, *i. e*. *id eſt*, that is.
I. H. S. *Jeſus Hominum Salvator*, Jeſus the Saviour of men.
Jan. January.
J. D. *Juris Doctor*, Doctor of Law.
J. U. D. *Juris utriuſque Doctor*, Doctor of both Laws, that is, of the civil and canon Law.
J. R. *Jacobus Rex*, King James.
Jul. July, Julius.
K. King.

Knt. Knight.
L. Liber, a book; *Libra,* a pound ſterling.
lb. a pound weight.
Ld. Lord.
L. J. C. Lord Chief Juſtice.
L. L. D. Legum Doctor; Doctor of Laws.
L. S. Locus Sigilli, the place of the ſeal in writings.
M. A. Maſter of Arts.
Mar. March.
M. D. Medicinæ Doctor, Doctor of Phyſic.
Mr. Maſter.
Mrs. Miſtreſs.
M. S. Manuſcript.
M. S. S. Manuſcripts.
M. S. Memoriæ Sacrum, Sacred to the Memory.
N. B. Nota Bene, Mark well.
N. S. New Stile.
Nov. or *9ber.* November.
O. S. Old Stile.
Oct. or *8ber.* October.
Oz. Ounce.
p. per, by.
Per cent. Per centum, by the hundred.
P. M. G. Profeſſor of Muſic in Greſham College.
Prof. Th. Gr. Profeſſor Theologiæ Greſhamenſis, Profeſſor of Divinity in Greſham College.
P. S. Poſtſcript.
Q. Queen, or Queſtion.
q. quadrans, a farthing.
q. d. quaſi dicat, as if he ſhould ſay.
q. l. quantum libet, as much as you pleaſe.
q. s. quantum ſufficit, a ſufficient quantity.
R. Rex, King; *Regina,* Queen.
R. P. Regius Profeſſor, King's Profeſſor.
R. S. S. Regiæ Societatis Socius, Fellow of the Royal Society.
S. or *St.* Saint.
S. Solidus, a ſhilling.
S. A. Secundum artem, according to Art.
S. N. Secundum Naturam, according to Nature.
S. T. P. or *S. S. T. P. Sanctæ* or *Sacro-Sanctæ Theologiæ Profeſſor,* Profeſſor of Divinity.
Sep. or *7ber.* September.
V. D. M. Verbi Dei (or *Divini*) *Miniſter,* a preacher of God's word.
v. vide, ſee.
viz. videlicet, to wit, or that is.

&c. et cetera, and the reſt, or, and ſo forth.

There are many other *abbreviations* uſed, and frequently without any propriety, and merely according to the caprice of the writer. It may be obſerved, however, that the beſt writers uſe the feweſt *abbreviations.* Some *abbreviations* contain a great number of letters, eſpecially in inſcriptions upon coins and medals. The inſcription upon our own coin runs thus: Georgius III. Dei Gratia, M. B. F. Et H. Rex. F. D. B. Et L. D. S. R. I. A. T. Et E. That is *Georgius Tertius, Dei Gratia, Magnæ Britanniæ, Franciæ, & Hiberniæ Rex, Fidei Defenſor, Brunſwicii & Lunenburgi Dux, Sacri Romani Imperii Archi-Theſaurarius & Elector.* George the Third, by the grace of God, King of Great Britain, France and Ireland, Defender of the Faith, Duke of Brunſwick and Lunenburg, Archtreaſurer and Elector of the Holy Roman Empire.

OF NUMBERS AND FIGURES.

Numbers are expreſſed either by theſe ſeven Roman Capital Letters, I. V. X. L. C. D. M. which are called *Numerals*; or by theſe ten characters, viz. 1, 2, 3, 4, 5, 6, 7, 8, 9, which are called *figures*, and 0, which is a *cypher*.

I. ſignifies One. V. Five. X. Ten. L. Fifty. C. a Hundred. D. Five Hundred. M. a Thouſand. 1. ſignifies one. 2. two. 3. three. 4. four. 5. five. 6. ſix. 7. ſeven. 8. eight. 9. nine. 0. nothing.

If a leſs *numeral letter* be placed before a greater, it takes away from the greater as many as the leſs one ſtands for; but if it be placed after a greater, it adds to it as many as the leſs one repreſents. Thus, the letter V. ſtands for *Five*. I placed before it takes *one* from it, and makes both together ſtand but for *Four*; as IV. But I. placed after the V. adds *one* to it, and makes both together ſtand for *Six*; as VI. Here follow ſome more examples.

IV. Four.	V. Five.	VI. Six.
IX. Nine.	X. Ten.	XI. Eleven.
XL. Forty.	L. Fifty.	LX. Sixty.
XC. Ninety.	C. a hundred.	CX. a hund. and ten.

Cyphers on the right hand of *Figures* increaſe their value ten times; 1 One, 10 Ten, 100 a Hundred, 400 Four Hundred, 8,000 Eight Thouſand. But on the left hand, they ſigniy nothing; as 03, 003, make but *Three,* 06, 006, 0006, make but *Six.*

A *Figure* at every remove from the right hand encreaſes its value *ten* times; as 4 *Four,* 45 *Forty-Five,* 456 *Four Hundred and Fifty Six,* 4567 *Four Thouſand Five Hundred and Sixty Seven.* I ſhall here give a more complete example of the uſe of *Numeral Letters* and *Figures.*

FIGURES.	NUMERAL LETTERS.
1. One	I.
2. Two	II.
3. Three	III.
4. Four	IV.
5. Five	V.
6. Six	VI.
7. Seven	VII.
8. Eight	VIII.
9. Nine	IX.
10. Ten	X.
11. Eleven	XI.
12. Twelve	XII.
13. Thirteen	XIII.
14. Fourteen	XIV.
15. Fifteen	XV.
16. Sixteen	XVI.
17. Seventeen	XVII.
18. Eighteen	XVIII.
19. Nineteen	XIX.
20. Twenty	XX.
21. Twenty-one	XXI.
22. Twenty-two	XXII.
23. Twenty-three	XXIII.
24. Twenty-four	XXIV.
25. Twenty-five	XXV.
26. Twenty-ſix	XXVI.
27. Twenty-ſeven	XXVII.
28. Twenty-eight	XXVIII.
29. Twenty-nine	XXIX.
30. Thirty	XXX.
40. Forty	XL.
50. Fifty	L.

60. Sixty

Figures.		Numeral Letters.
60.	Sixty	LX.
70.	Seventy	LXX.
80.	Eighty	LXXX.
90.	Ninety	XC.
100.	One Hundred	C.
200.	Two Hundred	CC.
300.	Three Hundred	CCC.
400.	Four Hundred	CCCC.
500.	Five Hundred	D or IↃ.
600.	Six Hundred	DC or IↃC.
700.	Seven Hundred	DCC or IↃCC.
800.	Eight Hundred	DCCC or IↃCCC.
900.	Nine Hundred	DCCCC or IↃCCCC.
1000.	One Thouſand	M or DIↃ.
1780.	One Thouſand Seven Hundred and eighty.	MDCCLXXX.

DIRECTIONS FOR SUPERSCRIBING LETTERS and ADDRESSING PERSONS of DIFFERENT RANKS and CONDITIONS.

To the Royal Family.

Superscription.	Address.
To the King; or to the King's moſt excellent Majeſty.	Sir; or, May it pleaſe your Majeſty.
To his Royal Highneſs, the Prince of *Wales*.	Sir; or, May it pleaſe your Royal Highneſs.

In the ſame Manner to any other branch of the Royal Family, altering only the Superſcription and Addreſs, according to the difference of title and ſex.

To the Nobility.

Superscription.	Address.
To his Grace B. Duke of C———	My Lord Duke, Your Grace.
To the moſt noble D. Marquis of E.	My Lord Marquis, Your Lordſhip.

To

To the Rt. Hon. F. Earl of G.	My Lord, Your Lordſhip.
To the Rt. Hon. H. Lord Viſcount J.	
To the Rt. Hon. K. Lord L.	

The Ladies are addreſſed according to the rank of their huſbands.

All the ſons of Dukes and Marquiſſes, and the eldeſt ſons of Earls, have, by the courteſy of England, the title of *Lord* and *Rt. Hon.*

The eldeſt ſon of a Duke, a Marquis, or an Earl, is likewiſe commonly diſtinguiſhed by the ſecond title of his father.

The younger ſons of Earls, and all ſons of Viſcounts and Barons, are ſtiled *Honourable*, and are *Eſquires*; as

To the Hon. M. N. Eſq;	Sir.

All the daughters of Dukes, Marquiſſes, and Earls are *Ladies*. All the daughters of Viſcounts and Barons are honourable; as,

To the Hon. R. S.	Madam.

The title of *Right Honourable* is given to all Privy Counſellors, to the Lord Mayors of London, York, and Dublin, and to the Lord Provoſt of Edinburgh.

All perſons bearing the King's commiſſion, are ſtiled *Honourable*; and every ſervant to the King on the civil or military liſt, or to any of the Royal Family, is ſtiled *Eſquire*.

To the PARLIAMENT.

To the Rt. Hon. the Lords Spiritual and Temporal, in Parliament aſſembled.	My Lords, May it pleaſe your Lordſhips.
To the Rt. Hon. the Knights, Citizens and Burgeſſes, in Parliament aſſembled.	Gentlemen, May it pleaſe your Honours.

To

To the Rt. Hon. C. D. Eſq; ſpeaker of the Houſe of Commons.	Sir.

To the CLERGY.

To the moſt Reverend Father in God B. Lord Archbiſhop of C.	My Lord, Your Grace.
To the Rt. Reverend Father in God F. Lord Biſhop of L.	My Lord, Your Lordſhip.
The Rev. B. C. D. D. Dean of G. or Archdeacon, Chancellor, or Prebendary of W.	Rev. Doctor. Mr. Dean. Rev. Sir.

All Rectors, Vicars, Curates, Lecturers, and Clergymen of other inferior denominations, are ſtiled *Reverend.*

The Officers of his Majeſty's houſehold are addreſſed either according to their rank and quality, or according to the nature of their office.

The Commiſſioners of the Civil Liſt are addreſſed according to their rank, and are ſtiled *Right Honourable*; as

To the Right Hon. the Lords Commiſſioners of the Treaſury, of the Admiralty, of Trade and Plantations, &c. Your Lordſhips.

The Commiſſioners of the Cuſtoms, Exciſe, Stamp-duty, Salt-duty, Navy, &c. are ſtiled *Honourable*; and if any of them are Privy Counſellors, they are ſtiled collectively *Right Honourable*—Sirs, your Honours.

In the army, all noblemen are ſtiled according to their rank, with the addition of their employment.

All Colonels were formerly ſtiled *Honourable*; as The Honourable G. H. but this method of addreſſing them is now grown obſolete. They are commonly addreſſed by their names only; as Colonel C. D. All inferior officers have the name of their employment ſet before their real name; as Major F. G. Captain L. M. &c.

In the navy, all noblemen are ſtiled according to their quality and office; and all admirals, who are not peers, are ſtiled *Honourable.* The other officers as in the army.

All Ambaſſadors have the title of *Excellency* added to their quality; as have all Plenipotentiaries and Governors abroad, and the Lords Juſtices of Ireland.

All Judges, if Privy Counſellors, are ſtiled *Right Honourable*; if not they are ſtiled *Honourable*; as,

To the Right Honourable C. P. Lord Chancellor.

To the Right Honourable Sir E. W. Lord Chief Juſtice.

To the Honourable L. M. Eſq; Lord Chief Baron.

To the Honourable R. S. Eſq; one of the Juſtices of &c.

All other Gentlemen of the Law are ſtiled according to their rank and office; every Barriſter having the title of *Eſquire* given him.

All Gentlemen in the commiſſion of the Peace have the title of *Eſquire* and *Worſhipful*; as have all Sheriffs and Recorders.

The Aldermen and Recorder of London are ſtiled *Right Worſhipful*; as are all Mayors of Corporations, except Lord Mayors.

The Governors of hoſpitals, colleges, &c. if conſiſting of magiſtrates, or having any ſuch among them, are ſtiled *Right Worſhipful*, or *Worſhipful*, as their titles may be. Incorporated bodies are called *Honourable*, as

To the Honourable Court of Directors of the Eaſt-India Company.	Gentlemen, Your Honours.
To the Honourable the Governor, Deputy-Governor, and Directors of the Bank of England.	Gentlemen, Your Honours.
Sometimes they are called *Worſhipful*;	as,
To the Maſter and Wardens of the Worſhipful Company of Drapers.	Gentlemen, Your Worſhips.

The wife of a Knight or Baronet is commonly diſtinguiſhed by the title of *Lady*, and every Gentleman of an independent fortune by that of *Eſquire.*

LETTERS ON VARIOUS OCCASIONS.

From a Father to his Son, lately entered into his Apprenticeſhip.

DEAR SON,

AS you have now been ſome time in your preſent ſituation, you muſt have had ſome experience of the nature of your buſineſs, which, I hope, you find equally conſiſtent with your health, and agreeable to your inclination. It is a buſineſs, in which many a man has made a conſiderable fortune. Your maſter began the world, with as little fortune as you have yourſelf; and yet he is now in a very flouriſhing way. And indeed I think myſelf greatly obliged to him for taking you without any fee or premium; the rather, as I am well aſſured, that he has had very conſiderable premiums with ſome of his other apprentices. This deficiency on your part (for it is certainly a great deficiency) you muſt endeavour to make up by ſuperior diligence and attention to his intereſt. This will not only be a proof of your gratitude, and endear you to your maſter; but it will be attended with the moſt beneficial conſequences to yourſelf. It will render you, more ſpeedily, a complete maſter of your buſineſs; and will give you, when you are out of your time, a much better chance of ſucceeding in the world, than thoſe who have paid the higheſt 'prentice fees. Nor is this any thing new or uncommon; for I have known ſome apprentices, who were taken without premiums, and almoſt upon charity, become, by their diligence, ſo expert in their buſineſs, and others, who had paid the higheſt premiums, remain, through their negligence, ſo entirely ignorant of it, that, when they had finiſhed their time, their maſters would rather give thirty pounds a year to the one, than thirty ſhillings to the other. But, in order to give you this favourable chance, you muſt endeavour to behave, during your whole apprenticeſhip, with the utmoſt diligence and ſobriety; you muſt endeavour to make your buſineſs your pleaſure: if you do not, you can never ſucceed in it; for whatever is done with conſtraint, can never be done well: and if at any time your maſter gives you a holiday, you muſt take care to ſpend it in the company of thoſe of your own character, not in that of the profligate and abandoned. Bad company, indeed, is the ruin of moſt young people; and therefore you muſt ſhun it with the greateſt care; for, as you have read in your Bible, "evil communication corrupts good manners:" and if you would know what bad company is, you may always be ſure, that thoſe are bad young men, who prefer their own pleaſure and amuſement to their maſter's buſineſs, and ſpend every hour they can ſpare, or more properly ſteal, from their neceſſary occupation, in taverns, play-houſes, and other places frequented by the vicious and idle. Let me therefore entreat you to be conſtantly on your guard againſt the company of ſuch people, and if at any time you are deſired to join in their parties, your anſwer is ready, that your maſter's buſineſs will not admit of your neglecting it ſo long. Your maſter, indeed, is one of the beſt men, and your miſtreſs one of the beſt women I ever knew; and I am ſure it will not be their fault if you do not live happy. Your brothers and ſiſters join in their love to you, as does your mother with me in ſending you our bleſſing. I ſhall be glad to hear from you as ſoon as convenient, and in the mean time am,

Your affectionate Father,

A. B.

From a Son to his Father, in anſwer to the above.

HONOURED SIR,

I Received your kind letter, and am greatly obliged to you for the good advice you give me, which I ſhall make it my conſtant ſtudy punctually to follow.

Indeed, I have very little temptation to deviate from my duty; for all my fellow-apprentices, as well as the clerks and journeymen, are ſo remarkable for their diligence and ſobriety, that I muſt either have a very weak head, or a very bad heart, to be greatly deficient in either of theſe good qualities. The fact is, that our maſter ſets us ſo good an example by a conſtant attendance upon his buſineſs, that, if we had no other motive, ſhame alone muſt reſtrain us from idling away our time, while he is huſbanding his with the greateſt œconomy. The opinion you entertain of my maſter and miſtreſs is extremely well founded. The one behaves to me ſo like a father, and the other ſo like a mother, that, excepting the circumſtance of my being obliged to attend to buſineſs a little more cloſely than formerly, I do not perceive any difference between my preſent ſituation and that which I was in, when under your own roof. With my love to my brothers and ſiſters, and my duty to my mother and you, I am,

Your obliged and obedient Son.

C. D.

From a Father to his Son, juſt entered into the ſervice of a Gentleman.

Dear Son,

NOTHING but my good opinion of your maſter's moral character could ever have induced me to conſent to your entering into the ſphere of life, in which you are now engaged. You will, no doubt, think yourſelf highly honoured by being admitted into the ſervice of a gentleman of ſo much conſequence as your maſter. Nor am I ſo proud as to think it any diſcredit to you; but neither am I, at the ſame time, ſo weak as not to foreſee, that, in your preſent ſituation, you will have a much worſe chance of gaining an eſtabliſhment in the world, than if you had entered into the ſervice of a farmer or tradeſman. In the latter caſe you would have learned a trade or profeſſion, and when you had ſcraped together a little money of your own, you might have ſet up in buſineſs for yourſelf. But, in your preſent ſituation, you will learn no trade but that of a gentleman; and a gentleman, without a fortune to ſupport his rank, is of all trades the moſt wretched and miſerable, if it be not rather a groſs impropriety of ſpeech to call it a trade at all. You have, indeed, one proſpect of getting a proviſion for life, and that is, that after you have ſerved your maſter a number of years, with equal diligence and fidelity, he may perhaps be ſo good as to procure you ſome little place in the exciſe, the cuſtoms, or ſome of the other public offices; and this, I believe, is the moſt uſual way of gentlemen's rewarding their old and faithful ſervants. But, in order to entitle you to this mark of his favour, you muſt firſt endeavour to deſerve it by an unwearied attention to his intereſt. Never ſuffer any of his property to be waſted or embezzled, but ſtudy the preſervation of it, as if it were your own. This cannot fail to endear you to your maſter, and render you a real bleſſing to him; for nothing can be a greater bleſſing to any man than a good ſervant, as, on the other hand, nothing can be a greater curſe than a bad one. And to qualify you the better for diſcharging your duty in this faithful and conſcientious manner, let me adviſe you to be conſtantly on your guard againſt the two vices, into which people in your way are moſt apt to fall: The vices I mean are idleneſs and extravagance. As you muſt have a great deal of leiſure time, you ſhould take care to ſpend it, not in card-playing, which is but too common a practice in great families; nor yet in fiddling, which is likewiſe very common among gentlemen's ſervants, and which, though not ſo irrational an amuſement as the former, is yet a very trifling one: but you ſhould employ all the time you can ſpare from your neceſſary buſineſs, in improving yourſelf in writing, arithmetic, and the practical parts of the mathematicks, ſuch as gauging, menſuration, land-ſurveying, and the like, which will not only be of great ſervice to you in your preſent ſituation, but will be ſtill more uſeful when you come to get ſome little livelihood of your own. As to extravagance, I have ſufficiently cautioned you againſt that in adviſing you to be careful of your maſter's property. This indeed is a vice, to which the ſervants of great families are very generally ſubject. Surrounded, as they perpetually are, not only with the neceſſaries and conveniences, but even with the luxuries and ſuperfluities of life, they think that as the ſource, whence all this plenty proceeds, has never been exhauſted, it is altogether inexhauſtible; and thus they waſte, and ſquander, and conſume, as if there were no end of their maſter's fortune. But, in order to cure them of this vicious and deſtructive habit, I would have them to reflect on the ſcanty fare which many of them had in their father's houſes. There, they well know, that, inſtead of the luxuries and ſuperfluities, they had not frequently the conveniences, and ſometimes hardly even the neceſſaries of life. Let me, therefore, entreat you, my dear ſon, to avoid theſe two vices with the greateſt care, and if you do, you cannot fail of being a good ſervant; which that you may, is the ſincere wiſh of

Your affectionate Father,
F. G.

From a Son to his Father, in anſwer to the foregoing.

HONOURED SIR,

YOUR account of the manner in which gentlemen's ſervants uſually ſpend their time, is ſo juſt, and agreeable to truth, that one would almoſt imagine you had been in that ſtation yourſelf, though I well know you never was. They are, for the moſt part, ſo idle and extravagant, that one would be almoſt tempted to think they had nothing elſe to do than to ſquander away their maſter's property. There are, however, a few exceptions to this general rule; and I hope I ſhall always make one of this ſmall, but honourable number. Indeed, unleſs I and my fellow-ſervants were of a very wicked and abandoned diſpoſition, we could not well be guilty of either of the vices you mention, as our maſter ſets us an example of the contrary virtues. He is ſo far from being idle, that he ſpends all his time (except what is neceſſary for recreation) either in reading, or writing, in looking into his accounts, or in converſation with a few ſelect friends: and though his table is plentifully, and even luxuriouſly covered, yet there is no waſte or extravagance; but whatever remains, after the family is ſatisfied, is all given to ſome poor families; in the neighbourhood. I ſhall endeavour to perfect myſelf in the different branches of learning you mention, that ſo, if my maſter ſhould be good enough to procure me a place, I may be able to diſcharge the duties of it in a proper manner. If not, I ſhall think it no hardſhip or diſgrace to return into the country, and purſue a life of honeſt labour and induſtry, as you have done before me. With my duty to my mother and you, and my love to my brothers and ſiſters, I am,

Dear Father,

Your obliged and obedient Son,

H. G.

From a Father to his Son, juſt beginning the World.

Dear Son,

As you are now entered into buſineſs for yourſelf, I ſhall here endeavour to give you the beſt advice and directions I can for the proper conduct and management of your affairs. In the firſt place, then, you will obſerve, that diligence and application is the very life and ſoul of all kinds of buſineſs. He that attends to his buſineſs only by fits and ſtarts, will never manage it well. Part of it will be entirely neglected, and even what is done, will be executed in ſo careleſs and ſlovenly a manner, that it had almoſt as well not be done at all. Method and regularlitles are no leſs neceſſary. By aſſigning certain portions of time for the diſcharge of each particular part of your buſineſs, and by finiſhing each within the time allotted, you will perform more real buſineſs in one day, than you could otherwiſe do in two.

Theſe things will not only be uſeful ſo far as they relate to yourſelf, but likewiſe as they relate to your ſervants. By ſetting them a good example, you will induce them to perform their duty with greater ſpirit and alacrity. Convince them that all your commands are founded in reaſon, and that you require nothing from them, but what you yourſelf would chearfully do, were you in their ſituation and they in yours. By theſe means you will bring them to ſerve you, not from a principle of fear, which is ſeldom productive of any good effect, but from a principle of love, which is always productive of the beſt. By treating them, not as ſlaves but as humble friends, you will induce them to conſider you, not as an imperious tyrant, but a kind and benevolent maſter, whoſe intereſt, therefore, they will be as ſtudious to promote, as if it were their own.

Another thing to be attended to, is the choice of your friends and boſom companions; thoſe whom you would wiſh to conſult on every trying and critical occaſion. But here the greateſt care and caution will be neceſſary; for a miſtake in this particular may in time be followed by the moſt fatal effects. It will, therefore, be proper for you to form a judgement of thoſe, whom you want to make your friends and adviſers, by the conduct they have obſerved in their own affairs, and the reputation they bear in the world. For he who has, by his own indiſcretion, ruined himſelf, is much fitter to be ſet up as a ſea-mark to warn others to ſhun his courſes, then as an example to be imitated. Old age is generally ſlow and heavy; youth headſtrong and precipitate: but there are old men, who are full of vivacity, and young men replete with diſcretion. You ſhould, therefore, be more careful in conſidering the conduct than the age of the perſons, with whom you intend to aſſociate; though, I muſt own, it appears to me a certain ſign of prudence and virtue in a young man, when the aged are pleaſed with his company, and he delights in theirs. Let it, therefore, be your conſtant endeavour to connect yourſelf with men of ſobriety, good ſenſe, and virtue; for the old proverb is certainly true, which ſays, "that a man is known by his company." If you can ſingle out ſuch men from the maſs of your acquaintance, you will at once improve from their converſation, and profit by their advice. But be ſure always to remember this maxim, that though you muſt be free and unreſerved in delivering your ſentiments when oocaſion requires, yet you ſhould be much readier to hear than to ſpeak, as indeed all wiſe men are; and here it was well obſerved by one of the ancients, that nature has given man two ears, and but one tongue. Lay up, therefore, by prudent obſervation and modeſt ſilence, ſuch a ſtock of knowledge in your early years, that, when you advance in life, you may make as reſpectable a figure as your ſeniors now do; and endeavour to profit by the misfortunes of others, rather than by your own. A ſilent youth generally makes a wiſe old man, and never fails to meet with reſpect from thoſe of a ſound and ſolid judgment.

When, therefore, you happen to be in the company of ſtrangers, let every one ſpeak before you deliver your ſentiments; for by this means you will be able to judge of the character and capacity of thoſe who are preſent, and, at the ſame time, will avoid the many mortifications, to which the forward are almoſt always ſubject. By carefully obſerving theſe maxims, and ſuch others as your own prudence will ſuggeſt to you, you cannot fail well of ſucceeding in the world; and that you may do ſo, is the ſincere wiſh of

Your affectionate Father,

J. K.

From

From a Servant, in his Maſter's abſence, to one of his country cuſtomers.

SIR,

MY Maſter happened to be from home when your letter arrived, and as your order would admit of no delay, I have endeavoured to execute it in the beſt manner I could. I know my maſter has a great regard for you, looks upon you as one of his beſt cuſtomers, and always expreſſes the ſtrongeſt deſire to oblige you: and, as his faithful ſervant, I have done my utmoſt to give you ſatisfaction, and am

Your moſt humble ſervant,

L. M.

DIRECTIONS *for learning to Write without the help of a Maſter.*

WRITING will never look well without a due proportion of the characters throughout the whole, a juſt diſtance between the letters themſelves as well as the words, a natural inclination of one letter to another, and a ſmooth ſtroke perform'd with boldneſs and freedom.

The proportion of letters is regulated by the O and N; therefore practiſe them firſt in a large character.

Make all your body-ſtrokes with the full, and all hair-ſtrokes with the corner of your pen.

Never turn your pen, nor alter the poſition of your hand.

Let your hair-ſtrokes be proportioned to your body-ſtrokes, and anſwer one another.

Your letters without ſtems muſt be even at the top and bottom.

Let your ſtems above be equal in length to *l* (*t* only excepted).

Your ſtems below muſt be equeal in length to *j*.

Let your capitals be equal in height to *l*, and a little ſtronger.

Let your words ſtand twice the diſtance of your letters, and your lines twice the length of *l*, that no ſtems may interfere.

Hold your pen between the two fore-fingers extended almoſt ſtrait, and the thumb bending outward with the hollow downwards, and the nib flat.

Let your paper lie directly before you, and your hand reſt only on the top of your little finger.

Reſt your arm lightly between the wriſt and the elbow.

Keep your body upright, and your elbow almoſt cloſe to your ſide.

Reſt your body on your left arm, and keep your paper down with your left hand.

Never lean hard on your paper.

In order to be able to write expeditiouſly in time, write ſlow at firſt.

Make the nib of your pen for the round and round text hands, the breadth of the full-ſtroke, and that part lying next the hand, ſomewhat ſhorter and narrower.

For the *Italian* hand make the nib ſomewhat finer, and the ſlit longer.

Note, In writing where figures are intermixed, they muſt always ſlope.

Your figures likewiſe muſt be larger than your writing.

When your figures are ranged in columns, make them upright.

How to make a PEN.

TAKE the firſt, ſecond or third quills in the wing of a gooſe or raven, (thoſe that are round and clean are the beſt:) when you have ſcraped off the thin rind thereof with the back edge of your penknife, hold it in your left hand with the feather end from you, then enter the back thereof ſloping, and cut off as much in length, as the quil is in breadth, and anſwer that with another cut on the inſide, like and oppoſite to the former; then turn the quill and enter the edge of your pen-knife even in the back thereof, and exactly in the midſt of the half-round, neither inclining the blade one way nor other, that the ſlit may not be made awry. Then put in the peg of your knife-haft, if it has one for that purpoſe, or the end of a whole quill, and with a ſudden twitch force up the ſlit, holding your left-hand thumb hard upon the back of the quill, to fix how far the ſlit ſhall go. This being done, enter your knife ſloping in the other ſide above the ſlit, about twice the breadth of the quill, and cut away the cradle piece; then turn the back upwards, and cut down to the end of the ſlit the cheek or ſhoulder-pieces, and in ſo doing turn the ſharp edge of your knife a little inward towards the ſlit. After this, place the inſide of the end or nib of the pen upon the nail of your left-hand thumb, holding the quill faſt between the fore and middle finger of that hand. *Laſtly,* To finiſh the nib, enter the edge of the knife, on the back, and near the end thereof ſloping, and immediately turning the edge almoſt downright, cut it off.

There are four things to be obſerved with regard to the Quill.

1. If the quill be too hard, ſteep it a while in water.
2. If it be too ſoft, harden it in embers.
3. If it be too thick, pare a ſmall quantity from the back of the nib.
4. If it be too thin and weak, ſtrengthen the pen with a ſhort ſlit, a ſhort nib, and a broad ſhoulder.

Materials for Writing.

A pen-knife razor-metal, quills good ſtore;
Gum Sandric powder, to pounce paper o'er;

Ink ſhining black, paper more white than ſnow,
Round and flat rulers on yourſelf beſtow;
Small compaſſes to rule your double lines,
Wax, ſand, and black-lead pens for your deſigns;
Theſe, with a willing mind, and ready hand,
Will make this art your ſervant at command.

A Receipt for good BLACK INK.

TO ſix quarts of rain or river water, (but rain-water is the beſt) put one pound and a half of freſh blue galls of *Aleppo* (for thoſe of *Smyrna* are not ſtrong enough) bruiſed pretty ſmall: eight ounces of copperas, clean, rocky, and green; alſo eight ounces of clean, bright, and clear gum arabic; and two ounces of rock allum: Let theſe ſtand together in a large ſtone bottle, clean ſtone pot, or earthen pot, with a narrow mouth to keep it free from duſt; ſhake, roll, or ſtir it well once every day, and you will have an excellent ink in about a month's time, and the older it grows the better it will be for uſe.

Ingredients for a Quart.

One quart of water, four ounces of galls, two ounces of copperas, and two ounces of gum, mixed and ſtirred as above.

☞ If you ſoak the green peelings of walnuts, (at the time of the year when pretty ripe) and oak ſaw-duſt, or ſmall chips of it, in rain-water, and ſtir it pretty often for a fortnight, and then ſtrain it, and add the ſame ingredients as above, the ink will be ſtronger and better.

The above is the common method of making *Writing-Ink*, and will be ſufficient for common occaſions; but the following compoſition will produce an ink vaſtly ſuperior, though attended with but little more expence and trouble than that given above.

A Receipt for making the moſt perfect Black Ink *yet known.*

TAKE a gallon of ſoft water, and boil it in a pound of Logwood chips for one hour. Take the decoction from the fire, and pour it from the chips, while boiling hot, upon a pound of *Aleppo* galls, beaten to powder, and two ounces of pomegranate peels, in a proper veſſel. After ſtirring them well together with a ſtick, place them at a ſmall diſtance from the fire, or, if in ſummer, in the ſun-ſhine, for three or four days, ſtirrnig the mixture often. At the end of that time add half a pound of green vitriol powdered; and let the mixture remain four or five days longer, taking care to ſtir it frequently; and then add farther four ounces of gum Arabic diſſolved in a quart of boiling water; and, after allowing the ink a proper time to ſettle, ſtrain it off from the dregs through a courſe linen cloth; and keep it well ſtopt for uſe.

If the ink is deſired to ſhine more, the proportion of gum Arabic muſt be increaſed.

How to make Red Ink.

TAKE three pints of vinegar, and four ounces of ground Brazil wood; ſimmer them together for an hour; then put in four ounces of rock allum, and one once of gum Arabic; and ſimmer theſe together for half an hour, and then ſtrain it through a flannel; bottle it up, well ſtopt, for uſe.

Or, you may diſſolve half an ounce of gum Arabic in half a pint of water; then put a pennyworth of vermillion into a ſmall gallipot, and pour ſome of the gum-water upon it, ſtir it well, and mix it together, with a hair pencil, to a proper conſiſtency: It will not incorporate preſently, but by the next day it will; then having a clean pen, dip it into the ink, having firſt well ſtirred it with the pencil; and then you may uſe it. It is a fine and curious red, though it does not flow ſo freely as the other. And after the ſame manner, you may make any other coloured ink, as blue, green, yellow, purple, &c. having divers gallipots for that uſe. In like manner you may mix the ſhell gold for curious occaſions, pouring two or three drops, according to diſcretion, into the ſhell, and mix it well with a clean hair pencil, and with it put a little into a clean pen, &c. The ſmall ſhells may be bought at ſome fan-painters, two or three for two-pence; or the large ones, (which are the beſt) at the colour-ſhops, at ſix pence a piece.

To keep INK *from* Freezing *or* Moulding.

IN hard froſty weather, ink will be apt to freeze; which if once it doth, it will be good for nothing; for it takes away all its blackneſs and beauty: To prevent which, (if you have not the conveniency of keeping it warm, or from the cold) put a few drops of brandy, or other ſpirits into it, and it will not freeze. And, to hinder its moulding, put a little ſalt therein.

COPIES in Verſe *Alphabetically digeſted.*

A.

ALL human things are ſubject to decay;
And when death ſummons, monarchs muſt obey.
Ape-like fond parents act extremely ill,
While with embraces, whom they love, they kill.
An honeſt man may take a knave's advice;
But idiots only will be cheated twice.

B.

BRAVE deeds and ſpotleſs virtue have
Rewards, which ſhall out-live the grave.
Brave minds oppreſs'd ſhould, in deſpite of fate,
Look greateſt like the ſun in loweſt ſtate.
Be thou the firſt true merit to befriend:
His praiſe is loſt, who ſtays till all commend.
By being fortune's friend, you ſhall have friends;
But in adverſity their friendſhip ends.

See how the doves to new-built houſes run,
And cautiouſly the ruin'd tower ſhun.
The empty barns no vermin ever haunt:
And no friend comes to him that is in want.

C.

CONTENT is all we aim at with our ſtore,
And having that with little need no more.
Cuſtom's a cruel tyrant; he that can
Well bear, or break its force, its more than man.
Cenſure none raſhly; nature's apt to halt:
Look inward: he's unborn that has no fault.
Children, like tender oziers, take the bow;
And, as they firſt are faſhion'd, always grow.

D.

DARING ambition loves to ſlide, not ſtand;
And fortune's ice prefers to virtue's land.
Death comes too ſoon in gay and proſperous days;
But in our miſery too long delays.
Delays are dangerous; take a friend's advice;
Begin, be bold, and venture to be wiſe.

E.

EXAMPLE is a living law, whoſe ſway
Men more than all the written laws obey.
Each good man is, in any place, at home;
The bad's an exile whereſo'er he come.
Ears we have two, one tongue, from whence 'tis clear,
Before we ſpeak once, we ought twice to hear.
Envy will merit, like a ſhade, purſue;
But, like a ſhadow, proves the ſubſtance true.

F.

FORTUNE a goddeſs is to fools alone:
The wiſe are always maſters of their own.
Friendſhip will not the leaſt reſerve endure;
But loves to ſhare in griefs it cannot cure.
Fear timely comes before a fault's begun:
He fears too late, who fears not till 'tis done.

G.

GREAT wit to madneſs ſure is near ally'd;
And thin partitions do their bounds divide.
Great wits, as well as warriors, only gain
Laurels and honours by their toil and pain.
Good nature and good ſenſe muſt ever join;
To err is human, to forgive divine.

H.

HE who pays more reſpect to wealth than ſenſe,
Would worſhip idols to increaſe his pence.
He who bewails, and not forſakes his ſin,
Confeſſes only what he'll do again.
He's rich, who never covets worldly pelf;
He's poor, who has enough, yet ſtarves himſelf.
Honour and ſhame from no condition riſe:
Act well your part, there all the honour lies.

I.

IMMODEST words admit of no defence:
For want of decency is want of ſenſe.
'Tis to detract to give one leſs than due;
Who gives as much, muſt be as learned too.
In all misfortunes this advantage lies,
They make us humble, and they make us wiſe.

K.

KNOW when to ſpeak, and ſilent when to ſit;
Fools ſilent often paſs for men of wit.
Know then this truth, enough for man to know;
Virtue alone is happineſs below.

L.

LIFE for delays and doubts no time does give;
None ever yet made haſte enough to live.
Leave God to manage for thee, and to grant
What his unerring wiſdom ſees thee want.
Laughter, if rightly uſed, may be confeſs'd,
In ſome ſort, to diſtinguiſh man from beaſt;

While by due management it is allay'd,
And the ſtrict rules of reaſon are obey'd:
But ſhews, if over loud, or over long,
Your head's but weak, altho' your lungs be ſtrong.

M.

MEN are more oft on earth than heaven intent,
And their induſtrious ſearch is downwards bent.
Marble, or braſs, devouring time may waſte;
But wit, as long as circling time, ſhall laſt.

N.

NONE more pragmatical in ſtate appear,
Than they whoſe judgments in their pockets are.
Next to the power of making tempeſts ceaſe,
Is, in a ſtorm, to learn to be at peace.
No minutes ſurely bring us more content,
Than thoſe in pleaſing uſeful ſtudies ſpent.

O.

OUR ſhoes and fortune ſure are near ally'd:
We limp in ſtrait, and ſtumble in the wide:
Obſerve in your diſcourſe the bounds of reaſon:
For ſenſe proves nonſenſe, ſpoken out of ſeaſon.
Our yeſterday's to-morrow now is gone,
And ſtill a new to-morrow does come on;
We by to-morrow draw up all our ſtore,
Till the exhauſted well can yield no more.

P.

PReſence of mind, and courage in diſtreſs,
Are more than armies to procure ſucceſs.
Premeditate your ſpeeches; words once flown,
Are in the hearers power, not your own.
Parts may be prais'd, good nature is ador'd;
Then draw your wit as ſeldom as your ſword.

Q.

QUickly lay hold of time, while in your power;
Be careful well to huſband every hour:

For time ſhall come, when you ſhall ſore lament
Th' unhappy minutes which you have miſpent.

R.

RIch men are not too rich, whom pride ne'er ſwells;
Nor poor men poor enough, in whom pride dwells.
Riches, like inſects, when conceal'd they lie,
Wait but for wings, and in their ſeaſon fly.

S.

SOrrow and joy are ne'er diſguis'd by art;
Our forehead ſhews the ſecrets of our heart.
Sicilian tyrants never yet could find
A greater torment than an envious mind.

T.

THE ſtupid world moſt honours pay to thoſe
Who on their underſtanding moſt impoſe.
The world's a wood, in which moſt loſe their way,
Though by a different path each goes aſtray.
Titles may ſet a gloſs upon our name;
But virtue only is the life of fame.
'Tis with our judgments as our watches; none
Go juſt alike, yet each believes his own.

V.

VIEW all the habitable world, how few
Know their own good, or knowing it purſue!
Virtue muſt be the faſhion of the town,
Before the beaus and ladies put it on.
Uſurpers ſeldom to the ſhades deſcend,
By a dry death, or with a quiet end.
Virtue's the chiefeſt beauty of the mind,
The nobleſt ornament of human kind:
Virtue's our ſafeguard, and our leading ſtar,
That guides our reaſon, when our ſenſes err.

W.

WHY ſhould we think of being others heirs?
Does not our ſand run out as faſt as theirs?
Who with their preſent ſtate are not content,
May find a worſe for their juſt puniſhment.

Want is a bitter and a hateful good,
Becauſe its virtues are not underſtood:
Yet many things impoſſible to thought,
Have been by want to full perfection brought.

X.

XERXES ſurvey'd his mighty hoſt with tears,
To think they'd die within an hundred years;
But by his own ill management we ſee,
They're all deſtroy'd, and dead in leſs than three.
Xantippe brawls, while Socrates is ſtill,
Yet ne'er was quiet, though ſhe had her will:
Her fury made him patient, her perplex'd,
That, when ſhe rag'd, ſhe could not make him vex'd.
Xerxes, as poets ſing, a haughty brave,
Whipt the rude winds, and made the ſea his ſlave:
But how return'd he, let us aſk again?
In a poor ſkiff he paſs'd the bloody main,
Choak'd with the ſlaughter'd bodies of his train.

Y.

YEſterday's paſt, to-morrow's none of thine;
To-day thy life to virtuous acts incline.
You parents, who your hopes in children place,
Teach them betimes to run in virtue's race.
You'll mend your life to-morrow, ſtill you cry:
In what far country does this morrow lie?
Youth is unfit great matters to contrive,
Their reaſon's weak, their judgment ſcarce alive.

Z.

ZEAL is a fire, and uſeful in its kind;
But nothing is more dangerous, if blind.
Zaleucus made his laws ſo ſtrict, that thoſe,
Who were adult'rers, both their eyes ſhould loſe.
Zeal for the public good with men is rare;
But for ſelf-intereſt, that's their chiefeſt care.

To write on Paper Gold Letters, *called* Shell Gold.

LAY a little leaf gold upon a fine earthen plate, and drop thereon a little clear virgin honey; then work it with your clean knife's haft, until it is ſtiff like paſte, and put it into an oyſter-ſhell; when you are to write with it, put a little gum-water on the ſide of the gold, and mix a little thin, fit for your pen.

How to write ſecret Letters.

WRITE what you would have ſeen on one ſide of the paper with common ink, and the other ſide, with milk, that which you would have ſecret; and, when you would make the ſame legible, direct your friend to hold that ſide, which is written with ink, to the fire, and the milky letters will ſhew bluiſh on the other ſide, and eaſy to be read.

Another Way.

RULE two papers of one bigneſs with lines at an equal diſtance, cut full of ſquare holes, which being laid upon another ſheet of paper, you may write your mind upon it through thoſe holes, and fill up the ſpaces with other words, which ought to hang together in good ſenſe, to prevent ſuſpicion. Each perſon to whom you write, muſt have one of the cut papers to read your letters; and this way of writing cannot be read by any one elſe.

Another Way.

YOU may firſt write a letter, that may carry good ſenſe, to your friend; but let the lines be wide aſunder: Then between your lines write your ſecret letter, with gall-water only, wherein the galls have been infuſed but a little time; for if, after you have written with it, there be any ſenſible colour left on the paper, you muſt throw away the water, and make new; this being dry, and of one colour with the paper, will give no cauſe of ſuſpicion; and the rather, becauſe the letter carries a ſufficient ſenſe already. Now, for the diſcovery of it, you muſt diſſolve ſome copperas in fair water, and with a fine pencil, dipt in the copperas-water, you muſt moiſten the interlining of your letter, and thereby you will make it legible.

How to write with Blue *and* Red Letters *at once, with the ſame Ink and Pen, and upon the ſame Paper.*

PUT the quantity of a hazel-nut of Litmoſe-blue to three ſpoonfuls of conduit-water, wherein ſome gum-arabic is diſſolved; and when it hath ſettled the ſpace of an hour, if you write therewith, you will have perfect blue letters: And if you dip a pencil in the juice of lemon, and wet ſome part of the paper therewith, and afterwards let your paper dry again, and then write upon the place where the juice of the lemon was laid, with your blue ink, the letters will ſuddenly become red, and in all the reſt of the paper the letters will be blue.

FORMS OF WILLS, BONDS, INDENTURES, AND OTHER LEGAL DEEDS.

A Form of a Will, a man having no Children.

IN the name of God, Amen. I A. B. of—— in the county of——, grazier, being of ſound and diſpoſing mind and memory, do make and ordain this my laſt will and teſtament, in manner and form following: That is to ſay, Firſt, I will, that all my debts and funeral charges be paid and diſcharged by my executrix herein after named. Alſo, I give and bequeath to my brother——of——the ſum of fifty pounds of lawful money of *Great Britain*. Alſo, I do give and demiſe unto——my ſiſter's ſon, all that cottage, or tenement, ſituate in the pariſh of——in the county of—— now in the occupation of—— with the cloſe adjoining to it, to the ſaid——his heirs and aſſigns for ever. Alſo, I do give unto——my loving wife all the reſt of my goods and chattels, and perſonal eſtate whatſoever. Alſo, I do give and demiſe unto ——my ſaid wife, her heirs and aſſigns for ever, all my lands and tenements lying in the pariſh of —— in the county of—— and now in the ſeveral occupations of——and——or their under-tenants, and alſo the meſſuage or tenement, ſituate in the pariſh of—— in the ſaid town of ——— and now in my own occupation, together with the orchard, and all the appurtenances thereunto belonging. Laſtly, I do make and conſtitute ——— my ſaid wiſe executrix of this my laſt will and teſtament. Dated this ——— Day of ———, in the year of our Lord, 1780.

A. B.

Note, There muſt be three witneſſes to the above will, becauſe there is a deviſe of lands.

Note, That a man may give his goods to any perſon by word of mouth, before three witneſſes, before his death; but it is much ſafer to do it by deed of gift in writing, in ſome ſuch form as the following:

A Deed of Gift of Goods.

TO all people unto whom this preſent writing ſhall come; I, C. D. of &c. ſend greeting: Know, ye, that I, the ſaid C. D. for divers and good cauſes, and valuable conſiderations, me hereunto moving, have given and granted, and by theſe preſents do give, grant, and confirm unto F. G. of &c. all and ſingular my goods, chattels, houſhold ſtuff, and all other my ſubſtance whatſoever, in whoſe hands, cuſtody, poſſeſſion, or keeping ſoever, the ſame are, or can, or may be found, to *have and to hold*, all and ſingular the ſaid goods, chattels, and houſhold-ſtuff whatſoever of me the ſaid C. D. unto the ſaid F. G. his executors, adminiſtrators and aſſigns, and from henceforth to his and their own proper uſe and uſes thereof, and therewith to do, order and diſpoſe, at his or their own wills and pleaſure, as of their own proper goods and chattels, freely, and peaceably, and quietly, without any manner of lett, trouble, or denial of me the ſaid C. D. or any other perſon or perſons whatſoever: Of all which premiſes I the ſaid C D. have put the ſaid F. G. in full and peaceable poſſeſſion by virtue hereof. In witneſs whereof, I the ſaid C. D. have hereunto ſet my hand and ſeal the 10th of *June*, 1780.

Sealed and delivered (being
firſt legally ſtamped) in the
preſence of ————

A Codi-

A Codicil, or Schedule to a Will, made after a Will is ſealed, &c.

BE it known unto all men by theſe preſents, That I, A. B. of &c. grazier, have made and declared that my laſt will and teſtament in writing, bearing date, &c. I the ſaid A. B. do, by theſe preſents contained in this codicil, confirm and ratify my laſt will, and do give and bequeath unto H. I. of &c. And my will and meaning is, that this codicil or ſchedule be eſteemed and adjudged to be part or parcel of my ſaid will and teſtament, and that all things therein contained and mentioned be faithfully performed, in as full and ample a manner, in every reſpect, as if the ſame were ſo declared and ſet down in my ſaid will. In witneſs whereof, I the ſaid A. B. have hereunto ſet my hand and ſeal the 3d day of July, 1780.

Another Will.

IN the name of God, Amen. I K. L. of &c. being through the abundant mercy and goodneſs of God, though weak in body, yet of a ſound and perfect underſtanding and memory, do conſtitute this my laſt will and teſtament, and deſire it may be received by all as ſuch: Firſt, I moſt humbly bequeath my ſoul to God my maker, beſeeching his moſt gracious acceptance of it, through the all-ſufficient merits and mediation of my moſt compaſſionate Redeemer Jeſus Chriſt, who gave himſelf to be an atonement for my ſins, and is able to ſave, to the uttermoſt, all that come unto God by him, ſeeing he ever liveth to make interceſſion for them, and who, I truſt, will not reject me, a returning penitent ſinner, when I come to him for mercy; in this hope and confidence I render up my ſoul with comfort, humbly beſeeching the moſt bleſſed and glorious Trinity, one God moſt holy, moſt merciful and gracious, to prepare me for the time of my diſſolution, and then to take me to himſelf into that peace and reſt, and incomparable felicity, which he has prepared for all that love and fear his holy name, Amen, bleſſed be God. I give my body to the earth, from whence it was taken, in full aſſurance of its reſurrection at the laſt day. As for my burial, I deſire it may be decent, without pomp or ſtate, at the diſcretion of my dear wife, and my executors hereafter named, who, I doubt not, will manage it with all poſſible prudence. As to my worldly eſtate, I will and poſitively order, That all my debts be paid. Firſt, I give to my dear and loving wife, for the term of her life, this houſe wherein I now dwell with all the furniture, and the lands and tenements that lie about it; and after her death, to my only ſon M. and his heirs and aſſigns for ever; to whom I leave alſo, from the time of my death, my other two eſtates ſituate in the pariſh of B. he paying to each of his ſiſters, P. and R. 500l. And if he die before them, and without iſſue, then his land (all but the value of 500l. which I freely empower him to diſpoſe of as he ſhall think fit) ſhall deſcend and belong equally to thoſe my two daughters. My poor debtors, who owe me ſome ſmall matters, which, becauſe they are low in condition, and not well able to pay them, I freely remit them all, forgiving ſuch my debts, as I deſire God would forgive my debts for Chriſt's ſake. I give 100l. to be diſtributed according to the diſcretion of my executors, among ſuch of my neighbours of this pariſh, as they apprehend moſt to want ſuch aſſiſtance, but who do not at preſent receive alms, nor have any allowance from the pariſh. I give 40l. towards that good work for teaching poor children to read, and to ſay their catechiſm in charity ſchools. The ſmall remainder of my eſtate I give to my very good friends, and dear and kind relations, A. B. and C. D. to be divided equally between them: And do conſtitute them executors of this my laſt will and teſtament, and truſtees for my wife and children. In witneſs whereof, I have hereunto ſet my hand and ſeal, the firſt day of March, in the year of our Lord, 1780.

Witneſſes, B. C. D. E. H. I.	K. L. (L. S.) Here I take off my ſeal, and do declare this to be my laſt will and teſtament.

Observations. ☞ *Note,* That the party who ſigns and ſeals this will, is to do it in the preſence of three witneſſes, who are to ſet their hands to it; but it is not of much conſequence whether the witneſſes hear the will read or no, provided they hear the party ſay he acknowledgeth that writing to be his will, to which he ſets his hand and ſeal; for, if they did hear it read, it cannot be ſuppoſed that they can remember the contents thereof. A man above fourteen years of age may make a will of his goods; and a woman above twelve. But neither can will their lands until twenty-one years.

If a man dies without a will, and leaves both free-lands and goods, his wife will have the third part of the profits of the land during her life, and one third part of the goods for ever; and the next a-kin to the huſband, the other two third parts. But he that makes a will, and leaves his wife a certain ſum to be paid her yearly, during her life, by his executor, ſhould alſo give her ſome of his moveable goods.

If a man dies without a will ſigned and ſealed, leaving many children, the eldeſt ſon claims all the land; but, if he leaves daughters only, they will be coheirs to all free-land.

Copyhold land is not given by will, but paſs'd by ſurrender in court.

Wills by word of mouth, called Nuncupative Wills, are not good to paſs freehold land; but for goods, or leaſehold land, they often paſs the court for good, if under 30l. value, the court writing one from the mouths of three or four witneſſes, to which they give oath, and put it in writing within ſix months after the party's deceaſe.

The word executor is the name given to him that is to ſee the will performed: But if it be a woman, ſhe is called in the will executrix.

The form of a letter of Attorney, to execute a particular Buſineſs.

KNOW all men by theſe preſents, that I F. G. of H. in the county of K. grazier, for divers good cauſes and conſiderations me hereunto moving, have made, ordained, conſtituted and appointed, and by theſe preſents do make, ordain, conſtitute, and appoint my truſty friend, M. N. of P. Gent. my true and lawful attorney, for me, in my name, and to my uſe, to aſk, demand, recover, and receive of, and from, R. S. of &c. the ſum of, &c. Giving, and by theſe preſents granting to my ſaid attorney, my ſole and full power and authority to take, purſue, and follow ſuch legal courſes for the recovery, receiving, and obtaining of the ſame, as I myſelf might, or could do, were I perſonally preſent; and, upon the receipt of the ſame, acquittances, or other ſufficient diſcharges for me, and in my name, to make, ſign, ſeal, and deliver: As alſo one or more attorney or attornies under him to ſubſtitute and appoint, and again at his pleaſure to revoke; and further to do, perform, and finiſh for me, and in my name, all and ſingular thing or things, which ſhall or may be neceſſary, touching and concerning the premiſes, as fully, thoroughly and entirely, as I the ſaid F. G. in my own perſon might, or could do, in or about the ſame: Ratifying, allowing, and confirming whatſoever my ſaid attorney ſhall lawfully do, or cauſe to be done, in and about the execution of the premiſes, by virtue of theſe preſents. In witneſs whereof, I have hereunto ſet my hand and ſeal, the 2d day of July, in the 20th year of the reign of our Sovereign Lord GEORGE the 3d, by the grace of God, king of *Great Britain*, &c. and in the year of our Lord God, 1780.

The Form of a Revocation of a Letter of Attorney.

KNOW all men by theſe preſents, That whereas I R. S. of L. in the county of K. grazier, upon the truſt and confidence which I had in M. N. of, &c. Gent. by letter of attorney under my hand and ſeal, bearing date, &c. did make, ordain, conſtitute and appoint the ſaid M. N. my lawful attorney, for me, and in my name, and to my uſe, to aſk, demand, recover, and receive, of and from A. B. of &c. ſalter, the ſum of &c. as thereby more at large may appear: Now know ye, that I the ſaid R. S. for divers good cauſes and conſiderations me hereunto moving, have, and by theſe preſents do revoke, diſannul, and make void the ſaid letter of attorney, and all power and authority therein to him the ſaid M. N. given. In witneſs, &c.

The Form of an Indenture for an Apprentice.

THIS Indenture witneſſeth, That A. B. ſon of C. D. &c. doth put himſelf apprentice to E. F. weaver, to learn his art or myſtery, and with him, after the manner of an apprentice, to ſerve from the day of the date hereof, for and during the term of ſeven years next enſuing; during all which term, the ſaid apprentice his ſaid maſter faithfully ſhall ſerve, his ſecrets keep, and all his lawful commands every where gladly do: He ſhall do no damage to his ſaid maſter, nor ſee it to be done by others, without letting or giving notice thereof to his ſaid maſter: He ſhall not waſte his ſaid maſter's goods, nor lend them unlawfully to any. He ſhall not commit fornication, nor contract matrimony during the ſaid term: He ſhall not play at cards, dice, or any other unlawful game, whereby his ſaid maſter may be damaged, with his own goods, or the goods of others: He ſhall not abſent himſelf day nor night from his ſaid maſter's ſervice unlawfully; nor haunt ale-houſes, taverns, or play-houſes; but in all things behave himſelf as a faithful apprentice, in the trade or myſtery he now followeth; and the ſaid maſter ſhall procure and provide for him ſufficient meat, drink, apparel, lodging, waſhing, and all other neceſſaries, during the ſaid term. And, for the true performance of all and every the ſaid covenants and agreements, either of the ſaid parties bindeth himſelf unto the other firmly by theſe preſents. In witneſs whereof, they have interchangeably ſet their hands and ſeals hereunto, this tenth day of July, in the twentieth year of the reign of our Sovereign Lord GEORGE the third, king of *Great Britain*, *France*, and *Ireland*, &c. and in the year of our Lord, 1780.

A Letter of Attorney from a Seaman.

KNOW all men by theſe preſents, That I G. R. mariner, now belonging to his Majeſty's ſhip the &c. for divers good cauſes and conſiderations me hereunto moving, have, and by theſe preſents do make, ordain, conſtitute and appoint my truſty friend T. S.

citizen and joiner of London, my true and lawful attorney for me, in my name, and for my uſe, to aſk, demand, and receive of and from the right honourable the treaſurer, or pay-maſter of his majeſty's navy, and commiſſioners for prize money, and whom elſe it may concern; as well all ſuch wages, and pay, bounty-money, prize-money, and all other ſum and ſums of money whatſoever, as now are, and which hereafter ſhall or may be due or payable unto me; alſo all ſuch penſions, ſalaries, ſmart-money, and all other monies and things whatſoever, which now, or at any time hereafter, are or ſhall be due to me for my ſervice, or otherwiſe, in any of his majeſty's ſhip or ſhips, frigates or veſſels: Giving and hereby granting unto my ſaid attorney full and whole power to take, purſue, and follow ſuch legal ways and courſes for the recovery, obtaining, and diſcharging the ſaid ſum and ſums of money, or any of them, as I myſelf might, or could do, were I perſonally preſent. And I do hereby ratify, allow, and confirm, all and whatſoever my ſaid attorney ſhall lawfully do, or cauſe to be done, in and about the execution of the premiſes, by virtue of theſe preſents. In Witneſs, &c.

A BOND.

KNOW all men by theſe preſents, That I [Adam Andrews, in the county of Eſſex, glover] am held and firmly bound unto [John Johnſon, of Brentford in the county of Middleſex, Eſq.] in the ſum of (two hundred) pounds of good and lawful money of Great Britain, to be paid to the ſaid [John Johnſon] his heirs, executors, adminiſtrators, or aſſigns: To which payment, well and truly to be made, I bind myſelf, my heirs, executors, adminiſtrators, and aſſigns, firmly by theſe preſents. Sealed with my ſeal. Dated the (ſecond day of *June*) in the (20th) year of the reign of our Sovereign Lord, GEORGE the third, by the grace of God king of *Great Britain*, *France*, and *Ireland*, defender of the faith, and in the year of our Lord God, 1780.

The CONDITION.

THE condition of this obligation is ſuch, that if the above-bounden [Adam Andrews] his heirs, executors, or adminiſtrators, do well and truly pay, or cauſe to be paid, uuto the abovementioned [John Johnſon] his executors, adminiſtrators, or aſſigns, the full ſum of (one hundred pounds) with lawful intereſt for the ſame, of good and lawful money of *Great Britain*, on the (2d day of *March*) next enſuing the date hereof; then this obligation to be void, or elſe to remain in full force.

Seal'd and deliver'd (being
firſt legally ſtamped) in Adam Andrews, (L. S.)
the preſence of R. C.
C. H.

☞ When a bond is given in conſideration of the value received, the bond is always to be made for double the value in the condition.

What is to be varied, and made agreeable to the circumſtances before you, is contained in thoſe words inſerted either between [ ] or ( )

A Condition to ſtand to the Award of Arbitrators.

THE condition of this obligation is ſuch, That if the above-bounden [Adam Andrews, of Chelmsford, glover] his heirs, executors, adminiſtrators, and every of them, do and ſhall in all things well and truly ſtand to, obey, abide by, perform, fulfil, and keep the award, order, arbitrament, final end and determination of [David Davis, and Frederick Ferrers, of Chelmsford, grocers] arbitrators indifferently named, elected, and choſen, as well on the part and behalf of the above-bounden [Adam Andrews] as of the above-named [John Johnſon] to arbitrate, award, order, judge, and determine of and concerning all manner of action and actions, cauſe and cauſes of actions, ſuits, bills, bonds, ſpecialties, judgments, executions, extents, accounts, debts, dues, ſum and ſums of money, controverſies, treſpaſſes, damages, and demands whatſoever, at any time or times heretofore had, made, moved, brought, commenced, ſued, proſecuted, done, ſuffered, committed, or depending by or betweeen the ſaid parties, ſo as the award may be made and given up in writing, under their hands and ſeals, ready to be deliver'd to the ſaid parties on or before the (ſecond of *June* next enſuing the date abovementioned:) But if the ſaid arbitrators do not make ſuch their award, of and concerning the premiſes, by the time aforeſaid; That then, if the ſaid [Adam Andrews] his heirs, executors, and adminiſtrators, for his and their parts and behalf, do in all things well and truly ſtand to, obey, abide by, perform, fulfil, and keep the award, order, arbitrament, umpirage, final end and determination of [Robert Reynolds, of Chelmsford, Eſq.] umpire, indifferently choſen betweeen the two parties, to end the ſame matter and differences, ſo as the ſaid umpire do make his award or umpirage, of and concerning the premiſes, and deliver the ſame in writing under his hand and ſeal, to the ſaid parties, on or before (the third of *May)* next enſuing the date aboveſaid: Then this obligation to be void, or elſe to remain in full force.

Seal'd and deliver'd (being legally ſtamp'd in preſence of, &c. Adam Andrews, (L. S.)

Note, Both the parties are in this caſe to be mutually bound; and, if there be no umpire admitted of, the latter part of the condition, beginning *(But if the ſaid arbitrators)* is to be omitted.

The Form of an Umpirage of Award.

TO all people to whom this preſent writing ſhall come: I [Robert Reynolds, of Chelmsford, Eſq.] umpire indifferently choſen between [Adam Andrews of Chelmsford, glover, *and* John Johnſon, of Brentford, Eſq.] ſend greeting: Now know ye, that I the ſaid [Robert Reynolds] having deliberately heard, and underſtood, the griefs, allegations, and proofs of both the ſaid parties; and being willing, as much as in me lieth, to ſet the ſaid parties at unity and good accord, do by theſe preſents arbitrate, award, order, deem, decree and judge, that the ſaid [Adam Andrews] his executors, adminiſtrators, or aſſigns, do and ſhall well and truly pay, or cauſe to be paid, unto the ſaid [John Johnſon] his executors, adminiſtrators, or aſſigns, the full ſum of (two hundred pounds) of lawful money of *Great-Britain*, on the (firſt day of *June*) next enſuing the date of theſe preſents; and that upon payment thereof the ſaid [Adam Andrews and John Johnſon] ſhall, at their own proper coſts and charges, ſeal, ſubſcribe, and, as their ſeveral acts and deeds, deliver each to the other, a general releaſe in writing, of all matters, actions, ſuits, cauſes of actions, bonds, bills, covenants, controverſies, and demands whatſoever, from the beginning of the world to the (ſecond day of *June* laſt paſt) and in the (20th) year of our Sovereign Lord, GEORGE, king of *Great-Britain*, &c. In witneſs whereof I have hereunto ſet my hand and ſeal, the 4th day of *July*, 1780.

Seal'd and deliver'd (be-
ing duly ſtamp'd) in Robert Reynolds, (L.S.)
preſence of, &c.

A Letter of Licenſe to a Debtor.

TO all people to whom this preſent writing ſhall come: We whoſe names are hereunto ſubſcribed, and ſeals affix'd, creditors of, (C. D. of London, merchant,) ſend greeting. Whereas the ſaid (C. D.) on the day of the date of theſe preſents, is indebted unto us ſeverally, in divers conſiderable ſums of money, which at preſent he is not able to ſatisfy unto us, without reſpite and time to be given unto him for the payment thereof: *Know ye therefore*, That we the ſaid creditors, for divers good cauſes and conſiderations as thereunto moving, have given and granted, and by theſe preſents do give and do grant unto the ſaid (C. D.) our ſure and ſafe conduct, and free licenſe, that he the ſaid (C. D.) ſhall and may ſafely come and go, and reſort unto us, and every one of us his ſaid creditors, to compound and take order with us, and every one of us, for all and every of our ſaid debts, and to go about any other buſineſs to any other perſon or perſons whatſoever, without any trouble, ſuit, arreſt, attachment, or other moleſtation to be offer'd or done unto him the ſaid (C. D.) his wares, goods, monies, or other merchandizes whatſoever, by us, or any of us, or by the heirs, executors, adminiſtrators, partners or aſſigns of us, or any of us, or by our, or by any of our means and procurement, to be ſought or procured to be done, from the day of the date hereof, unto the full end and term of *(one whole year)* next enſuing. And we the ſaid creditors, whoſe names are here underwritten, do hereby covenant and grant, and every one of us for his own part, his executors and adminiſtrators, covenanteth and granteth, to and with the ſaid (C. D.) that if any trouble, wrong, damage or injury ſhall be done unto him the ſaid (C. D.) either in his body, goods, or chattels, or any of them, within the ſame term of *(one year)* next coming after the date hereof, by us, or any of us, his ſaid creditors, or by any other perſon or perſons, by or thro' the procurement, conſent, or knowledge of us, or any of us, contrary to the true intent and meaning of this our preſent writing of ſafe conduct, that then the ſaid (C. D.) by virtue of theſe preſents, ſhall be diſcharged and acquitted for ever, towards and againſt him and them, of us, him and his heirs, executors, adminiſtrators, partners or aſſigns, and every one of them, by whom, and by whoſe means he ſhall be arreſted, troubled, and attacked, or damnified, of all manner of actions, ſuits, quarrels, debts, and demands, either in law or equity, from the beginning of the world, to the day of the date hereof: In witneſs whereof, we have hereunto ſet our hands and ſeals, the firſt day of *March*, 1780.

Seal'd and deliver'd (being firſt duly ſtamped) in preſence of, &c.	F. G. H. I. K. L.	(L.S.) (L.S.) (L.S.)

A Bill of Sale.

KNOW all perſons whom it may concern, That I [James Jolliffe, of *Liverpool*, in the county of Lancaſter, hoſier,] for and in conſideration of the ſum of (fifty pounds) of lawful money of Great Britain, to me in hand paid, by [William Walters, of *London*, Eſq.] the receipt whereof I do hereby acknowledge, have bargain'd, ſold, and delivered, and by theſe preſents according to the due form of law, do bargain, ſell, and deliver unto the ſaid [William Walters] two hundred pair mens hoſe, one hundred pair womens ditto, fifty boys ditto; to have and to hold the ſaid bargain'd premiſes unto the ſaid [William Walters] his executors, adminiſtrators and aſſigns, for ever. And I the ſaid [James Jolliffe] for myſelf my executors and adminiſtrators, the ſaid bargain'd premiſes unto the ſaid [William Walters] his executors, adminiſtrators and aſſigns, againſt all perſons, ſhall and will warrant, and for ever defend, by theſe preſents; * Provided nevertheleſs, that if I the ſaid [James Jolliffe] my executors, adminiſtrators, or aſſigns, or any of us, do and ſhall well and truly pay, or cauſe to be paid unto the ſaid [William Walters] his executors, adminiſtrators, or aſſigns, the ſum of (fifty-one pounds ten ſhillings, as principal and intereſt, lawful money of Great-Britain, on the tenth of Auguſt next enſuing the date hereof) for redemption of the bargain'd premiſes; then this preſent bill of ſale ſhall be void and of none effect: But if default be made in the payment of the ſaid (fifty one pounds ten ſhillings) in part, or in the whole, contrary to the manner and form aforeſaid, that then it ſhall remain and be in full force and virtue, In witneſs whereof, I have hereunto ſet my hand and ſeal. the firſt day of March, in the year of our Lord, 1780.

Seal'd and deliver'd, &c. James Jolliffe, (L.S.)

A general Releaſe.

KNOW all men by theſe preſents, That I [Peter Parker, of *London*, brazier,] have remiſſed, releaſed, and for ever quitted claim unto [Francis Free, citizen and baker of *London*,] his heirs executors, and adminiſtrators, all and all manner of actions, cauſe and cauſes of actions, ſuits, bills, bonds, writing obligatory, debts, dues, duties, accompts, ſum and ſums of money, judgments, executions, extents, quarrels, controverſies, treſpaſſes, damages and demands whatſoever, both in law and equity, or otherwiſe howſoever, which againſt the ſaid [Francis Free] I ever had, now have, and which I, my heirs, executors, and adminiſtrators, ſhall or may have, claim, challenge or demand, for or by reaſon or means of any matter, cauſe or thing, from the beginning of the world to the day of the date of theſe preſents. In witneſs whereof, I have here-unto ſet my hand and ſeal, the third day of *July*, in the year of our Lord, 1780.

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* If the bargained premiſes be redeemable, by a limited time, a proviſo of this nature is added,

Sign'd, ſeal'd, and deliver'd,
(being firſt legally ſtamp'd) Peter Parker, (L.S.)
&c.

Forms of Receipts, Notes, Bills of Parcels, &c.

Various Forms of Acquittances, when an Apprentice or Servant receives Money for the Uſe of his Maſter or Employer.

RECEIVED, the 10th of Auguſt, 1780, of Mr. Peter Paterſon, ten pounds, ten ſhillings, for my maſter, Henry Horn, on account,

Per William Wade.

£. 10 10

Received, the 1ſt of May, 1780, of Oliver Onſlow, ſeventy-five pounds, fifteen ſhillings, and ſixpence, in full payment for my Uncle John Jennings,

£. 75 15 6 Per David Dawſon.

Received, the 18th of June, 1780, of the worſhipful company of Stationers, eighty ſeven pounds, for my brother, George Gregory,

£. 87 Per Gabriel Gregory.

Received, the 27th of April, 1780, of Mr. Henry Hinton, twenty-five pounds, for half a year's rent, due laſt Lady day, for my maſter, Robert Ray,

£. 25 Per Samuel Simpſon.

Received the 9th of September, 1780, of Mr. Humphry Higgins, by order and on account of Mr. James Jeffreys, two hundred and fifty pounds, ten ſhillings, and ſixpence, for Mr. William Wilſon, and company,

£. 250 10 6 Per Adam Aſhley.

Received the 10th of October, 1780, of Mr. Peter Preſcot, forty-three pounds, eight ſhillings, and ſixpence, in part of a bill of one hundred pounds, payable to Mr. Ralph Rawlinſon, due the 1ſt inſtant,

£. 43 8 6 Per Richard Rogers.

Various Forms of Acquittances, upon Receipt of Money, by Maſters and Men of Buſineſs themſelves.

RECEIVED this 4th of May, 1780, of Mr. John Jardine, two hundred and ten pounds on account,

£. 210 Per Thomas Tate.

Received the 5th of June, 1780, of William Webb, Eſq. the ſum of four hundred and thirty pounds, in full of all demands, for ſelf and company,

£. 430 Per Thomas Tonſon.

Received the 10th of March, 1780, of Mr. David Dawſon, the ſum of five pounds, five ſhillings, in part of my ſalary,

£. 5 5 Per Edward Evans.

Received the 8th of April, 1780, of Mr. Samuel Sims, fifty pounds, in full for the difference of four thouſand pounds bank ſtock,

£. 50 Per Henry Hughes.

Received the 4th of July, 1780, of Mr. Jacob Jones, twenty pounds, in full for one year's intereſt of four hundred pounds, due at Midſummer laſt,

£. 20 Per George Green.

Received the 12th of January, 1780, by the order and for the uſe of Mr. Peter Page, of Mr. James Jay, ten pounds, and allowed for taxes and repairs three pounds, in full for half a year's rent due at Chriſtmas,

£. 13 Per Peter Pugh.

Received the 10th of July, 1780, of the executors of Henry, late Lord Holland, by the hands of Mr. John Brett, the ſum of ſixty pounds, in full for my half year's annuity due at Midſummer laſt,

£. 60 Per George Jones.

Promiſſory Notes by Bankers Apprentices and Servants.

London, May 17th, 1780.

I Promise to pay Thomas Trot, Eſq. or bearer, on demand, eighty pounds,

For Mr. Henry Hoare and partners,

£. 80 Per William Wynne.

London, March 15th, 1780.

I promiſe to pay to the governor and company of the bank of England, or bearer, on demand, ſix hundred pounds,

For my uncle John Jebb,

£. 600 Per James Jebb.

London, November 9th, 1780.

I promiſe to pay to the royal African company, or bearer, on demand, five hundred and fifty pounds, ten ſhillings, and ſixpence, for my Maſter, Peter Pitt,

£. 550 10 6 Per Hugh Hill.

Promiſſory Notes for a Man's Self, &c.

I Promise to pay to Mr. Robert Rich, or bearer, on demand, nine hundred pounds, March 18, 1780.

£. 900 Per Paul Percy.

I promiſe to pay to the royal African company on demand, three thouſand pounds, June 6th, 1780, for ſelf and partners,

£. 3000 Per George Gay.

I promiſe to pay to Ralph Ray, Eſq. or order, on demand, five hundred and ten pounds, ten ſhillings, and ſixpence, value received this 19th of June, 1780.

£. 510 10 6 Per Francis Free.

I promiſe to pay to Sir Simon Sim, or order, the ſum of ninety pounds in manner following; thirty pounds, part thereof, two months after date, thirty pounds more the 10th of May next, and the remaining thirty pounds the 29th of July, 1781, value received: Witneſs my hand at *London*, the 28th of June, 1780,

£. 90 Per Peter Pratt.

London, July 8th, 1780.

I promiſe to furniſh Mr. Henry Hill, on demand, with bills of exchange to the value of ten thouſand pounds *Sterling*, at the price current, payable to himſelf, or

ordre,

order, in Antwerp, the next enſuing fair, value of Sir Charles Aſgill received,

£. 10,000 Per Robert Renny.

I promiſe to pay to Peter Perry, Eſq. or order, the ſum of ſixty pounds on demand, after the receipt of a bill of exchange drawn the 10th current, by Paul Price, on John James, of Briſtol, grocer, for the like ſum, payable to William Wiſe, Eſq. or order, which the ſaid Peter Perry, has indorſed to me this 10th of June, 1780,

£. 60 Per Adam Anſon.

A Promiſſory Note, mentioning order, is indorſable from one perſon to another, which is done by the preſent poſſeſſor's writing his name on the back of it, and delivering it up to the party, to whom he intends to aſſign over his property therein.

It is unneceſſary to have a promiſſory note, payable to bearer, indorſed, if you are ſatisfied the note is good.

The delivering up a promiſſory note to the perſon who ſigned it is a ſufficient voucher of its being paid; nor is there any need of writing a receipt thereon.

Promiſſory notes, and book debts, if not legally demanded in the ſpace of ſix years, cannot be recovered by law, upon the debtor's pleading the ſtatute.

If you keep a promiſſory note upon demand in your own hands above three days, and the perſon it is upon ſhould fail, the loſs will be your own; but if he fail within three days, it will light in equity on the perſon that paid it you.

N.B. *Obſerve in Promiſſory Notes, that the value received is mentioned: or they are of no force.*

BILLS OF PARCELS.

A Linen-Draper's Bill.

Mrs. Anne Adams,
1780, Bought of James Jay and partners.

June 3,	s.	d.		l.	s.	d.
20 Ells of Holland at	5	6	per ell	5	10	0
10 Ells of dowlas at	1	6		0	15	0
1 Piece of cambrick			——	4	10	6
A Piece of muſlin			—— ——	3	5	6
50 Ells of diaper at	1	6	——	3	15	0
				17	16	0

An Hoſier's Bill.

Mrs. Jane Page,
1780. Bought of John James.

May 12,		s.	d.	
25 Pair of womens worſted mixt	at	4	6	per pair.
13 Ditto of mens ſilk ——	at	14	4	——
12 Ditto of mens yarn ——	at	2	6	——
28 Ditto of Norwich hoſe ——	at	3	4	——
18 Ditto of thread ——	at	3	6	——
33 Ditto of womens gloves ſilk	at	5	6	——

A Milliner's Bill.

Mrs. More,
1780, Bought of Anne Anſon.

June 22,		s.	d.		l.	s.	d.
12 Yds. of flower'd ribband	at	2	6		1	10	0
5 Pair of Roman gloves	at	8	6	per pair	2	2	6
4 Dozen Iriſh lamb do.	at	1	7	——	3	16	0
9 Sarſenet hoods, white	at	5	0	——	2	5	0
10 Fans, French mount	at	3	9	——	1	17	6
A piece of Mechlin lace 19 yards at —— }		11	10	per yd.	11	4	10
					22	15	10

A China

A China Man's Bill.

The right honourable Lady Monſon,
1780, Bought of Luke Lacy.

March 9,		l.	s.	d.				
16 China plates ——	at	0	4	6	each			
10 Diſhes ditto ——	at	0	8	4				
3 Pair of jars and a pair of beakers allow'd at		——	——			15	8	10
A tea table ſet compleat, at		——	——			4	10	6
Indian ſprig'd muſlin, 1 ps. qt. 10 yards, at		0	0	9				
Fine chints 10 pieces ——	at	0	4	4	per piece			

A Fiſhmonger's Bill.

Mr. Henry Hall,
1780, Bought of Simon Scot,

May 18,		l.	s.	d.				
4 Hundred of haberdine	at	6	8	4	per C.			
2 Hundred of Ling——	at	——	——	——	——	18	10	4
3 Hundred of Stockfiſh	at	3	10	6	per C.			
2 Caggs of Sturgeon—	at	0	8	4	per Cagg			
10 Barrels of herrings —	at	2	17	6	per barrel			
74 Dried ſalmon ——	at	0	6	4	each			

A Teaman's Bill.

John Jebb, Eſq.
Bought of Robert Ray, March 2, 1780.

℔.		s.	d.	
20 Of Smyrna Coffee —	at	6	6	per ℔.
43 Of Mocha ditto —	at	5	10	——
19 Of Imperial tea —	at	25	0	——
12 Of the beſt bohea —	at	12	6	——
14 Of royal green tea —	at	17	6	——
30 of ſugar double refined	at	1	2	——

A Pewterer's and Brazier's Bill.

Mr. Evan Ellis,

1780,		Bought of Peter Pitt,			
July 16,		*l.*	*s.*	*d.*	
Hard metal plates 4 doz. wt. 50 ℔.	at	0	1	5	pr pound
8 Diſhes do. a monteth, and culiender, wt. 44 ℔.	at	0	1	7	ditto
A copper with a diſcharging cock, wt. 70 ℔. ——	at	0	1	6	ditto
Iron work to do. and a crane, wt. 9 ℔. ——	at	0	0	3	ditto
A ſtove-grate, with ſhovel, tongs, poker, and fender	at	0	1	9	
A large braſs pot and ſaucepan wt. 38 ℔. ——	at	0	1	8	

A Cheeſemonger's Bill.

Mr. Adam Andrews,

1780,					Bought of James Jones,			
November 10,	C.	q.	℔.		*l.*	*s.*	*d.*	
14 Old Cheſhire cheeſes	6	1	10	at	1	18	6	per C.
47 Glouceſterſhire ditto	5	1	8	at	1	13	0	——
4 Tedder ditto ——	3	1	21	at	2	14	6	——
9 Flitches of bacon, wt.	57 ſtone			at	0	3	6	pr ſtone
14 Firkins of butter ——				at	1	12	0	each
Suffolk butter ——	13 weys			at	8	1	6	per wey

A Grocer's Bill.

Mr. Thomas Tonſon,

1780,	Bought of John Johnſon and Co.							
March 14,	C.	q.	℔.		*l.*	*s.*	*d.*	
Sugar 3 hhds. nt.	23	3	16	at	1	4	6	per C.
Raiſins 4 barrels	16	1	10	at	1	15	7	——
Rice 2 barrels —	2	2	6	at	4	18	8	——
Pepper 2 bags —	2	1	10	at	2	18	10	——
Brimſtone ——	1	2	20	at	2	3	0	——
Bees wax 4 cakes —	3	1	7	at	1	17	6	——

A Mercer's Bill.

Mrs. Catharine Collet,
Bought of Patrick Pugh and Simon Sims,

June 10, 1780,		s.	d.	
14 Yards of rich brocaded ſattin	at	12	6	pr yard
8 Do. of mohair ———	at	5	4	———
28 Do. of Paduaſoy ——	at	10	6	———
17 Do. of flower'd damaſk —	at	8	10	———
44 Do. of poplin ——	at	2	8	———
14 Do. of Italian Mantua —	at	7	6	———
17 Do. of double Taffety —	at	3	1	———

When the money is paid down, either of the partners may write,

Received the contents in * *full of all demands, for ſelf and partner,*

per Simon Sims.

A Woollen Draper's Bill.

Mr. Henry Hartley,
Bought of David Davis and Co.

Jan. 10, 1780,		s.	d.	
12 Yards of Yorkſhire cloth —	at	7	6	per yard
9 Do. of fine Spaniſh black —	at	17	6	———
8 Do. of fine grey cloth —	at	16	8	———
20 Do. of frieze ———	at	4	6	———
6 Do. of fine drab ———	at	14	4	———
57 Do. of ſuperfine Spaniſh cloth	at	17	0	———
24 Do. of livery ſcarlet cloth	at	12	6	———

Receiv'd the full contents, for David Davis *and Company,*

per Daniel Drake.

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* N. B. When the words "in full of all demands" are inſerted, a two ſhilling ſtamp is required.

BILLS on BOOK-DEBTS.

An Upholſterer's Bill.

The right honourable the Earl of Egmont.
1780, Bought of Francis Freeman,

		l.	*s.*	*d.*
March 10,	A rich crimſon damaſk bed laced compleat	80	0	0
May 11,	A ſet of window curtains and vallance ditto ——	20	10	6
June 4,	A fine carpet, counterpane, and an otter down quilt	14	10	6
July 9,	A crimſon velvet eaſy chair, and 4 ſtools ditto ——	19	8	6
—17,	A wrought bed dimity, and furniture compleat —	30	10	6
Aug. 12,	A down bed, bolſter, pillows, with a mattreſs and quilt	16	0	0
—14,	Chairs 12 with two arm'd do. walnut-tree fram'd —	36	10	6
	Sum £.	217	10	6

If a ſervant receives the bill, let the receipt run thus,
Received the 10*th of* December, 1780, *of the Right Hon. the Earl of* Egmont, *by the hands of* Mr. Simon Steward, *the full contents, for my maſter* Francis Freeman,

Per C. Child.

A Goldſmith's Bill.

The honourable Sir George Saville, Bart.
1780, Bought of William Weſt,

		oz.	dwts.	gr.		*s.*	*d.*
March 10,	For a ſilver ſet of caſtors	27	8	9	at	6	10
May 9,	Half a dozen of ſoup plates	76	10	14	at	6	8
—12,	A ſilver tea-pot and lamp	28	14	11	at	6	9
June 12,	A large punch bowl	71	5	11	at	7	2
July 7,	A doz. of ſilver ſpoons	34	6	8	at	6	10

A Ca-

A Cabinet-Maker's Bill.

The right honourable the Earl of Eſſex,
1780, Bought of William White,

1780,		l.	s.	d.
April 10,	A chimney glaſs and a pair of ſconces	6	12	6
May 4,	A pair of pier glaſſes 80 inches by 20, in gilt frames ——	40	0	0
June 9,	A pair of India cabinets 48*l.* each	96	0	0
——24,	A fine Indian four-leav'd ſcreen, and fire ſcreen ——	20	10	6
July 15,	A book caſe with glaſs doors, and a corner cupboard, do	24	0	0
——28,	A walnut-tree table and a ſet of dreſſing boxes japann'd —	4	6	6
Aug. 9,	A tea table and ſtand plated, wt. 120 oz. at 10*s.* per ounce	60	0	0
——23,	Two dozen of fine matted chairs at 8*s.* each ——	9	12	0
		£. 261	1	6

Received the 16*th of* September, 1780, *of the Right Hon. the Earl of* Eſſex, *the contents in full of this bill for Mr.* William White,

Per Robert Ray.

A Factor's Bill.

Meſſrs. Stone and Strutt,
1780, Bought of John Jacob, and company.

May 8,			s.	d.		l.	s.	d.
	For Serge de Niſmes 15 ps. each 40 yards	at	4	0	per yard	120	0	0
June 9,	Silk drugget 20 each 30 yards	at	6	0	ditto	180	0	0
July 1,	Grograms 10 each 40 yards	at	3	0	ditto	60	0	0
17,	Silk camblets 20 each 30 yards	at	4	0	ditto	120	0	0

Aug. 8, Duroys 50 ——	at 30	0	per piece	75	0	0
Dec. 9, Sagathies 25 each 20 yards	at 1	6	per yard	37	10	0
				£. 592	10	0

A Lighterman's Bill.

Mr. George Green, Dr.

1780,	To John Jay,						
May 8,	*l.*	*s.*	*d.*		*l.*	*s.*	*d.*
Coals in the pool 50 chaldrons at	1	5	0	pr ch.	62	10	0
Metage of 50 chaldrons at	0	0	8	——	1	13	4
Lighterage of ditto — at	0	0	10	——	2	1	8
Wharſage of ditto —— at	0	0	2	——	0	8	4
Cartage of ſaid 50 chaldrons at	0	2	6	——	6	5	0
					£. 72	18	4

N. B. One and twenty chaldrons are the ſcore of ſea-coal.

A Wine Merchant's Bill.

Mr. Samuel Scott,

Bought of Mark May,

1780,			*s.*	*d.*			
May 20,	Palm ſack 20 gallons,	at	10	0	per gall.		
June 18,	Port Red 40 ditto —	at	6	0	————		
July 29,	Sherry 28 ditto ——	at	7	0	————		
——31,	Rheniſh 16 ditto —	at	7	2	————		
Aug. 10,	White Liſbon 40 do.	at	4	8	———		
——17,	A cheſt of Florence agreed for				——	3	18

A Brick-

A Bricklayer's Bill.

Sir Charles Crofts, Dr.
To George Gray, for work and materials in his houſe on Cornhill, London.

1780,			s.	d.		l.	s.	d.
May 16,	Bricks 30 thouſand	at	16	0	pr M.	24	0	0
—28,	Tiles 10 ditto —	at	18	0	———	9	0	0
June 4,	Lime 30 hundred	at	14	0	pr H.	21	0	0
—10,	Sand 16 loads —	at	3	6	pr L.	2	16	0
July 17,	Ridge tiles 200 —	at	8	0	pr H.	0	16	0
Sept. 19,	Work for myſelf 60 days	at	3	6	per D.	9	0	0
——	Do. for a labourer 60	at	1	6	———	4	10	0
——	Do. for my man 60	at	2	6	———	7	10	0
						£.78	12	0

Note, A brick ought to be 9 inches long, 4½ broad, and 2½ thick: 500 bricks are a load, 1000 tiles the like, 25 buſhels are a hundred of lime; about 3000 bricks will make a rod of brick-work, viz. 272½ ſquare feet, a brick and a half thick.

A Builder's Bill.

His Grace the Duke of Marlborough, Dr.
To Peter Pine, for work and materials in Blenheim-Houſe.

1780,			l.	s.	d.		l.	s.	d.
May 19,	Oaken timber 16 loads	at	3	0	0	a load	48	0	0
—24,	Fir timber 40 tons —	at	0	10	6	a load	21	0	0
June 9,	Oaken plank 80 feet	at	0	0	4	pr foot	1	6	8
—19,	Norway deals 600	at	6	0	0	pr H.	36	0	0
——	Sixpenny nails 30 thouſand	at	0	4	0	pr M.	6	0	0

July

			l.	s.	d.		l.	s.	d.
July 4,	Ten groat nails 2000 —	at	0	14	0	pr M.	1	8	
Aug. 20,	Work for myſelf 80 days	at	0	3	6	pr day	14	0	0
——	Do. for 4 men 80	at	0	2	6	each	40	0	0
——	Wainſcot 70 yards	at	0	3	0	pr yd.	10	10	0
——	Double quarter 60 feet ——	at	0	0	4	pr foot	1	0	0
							£. 179	4	8

Note, Deals and nails are 120 to the hundred; 50 feet are a load, and 40 feet a ton of timber.

A Corn Chandler's Bill.

George Gay, Eſq.

Bought of Peter Pott and partners,

1780,				s.	d.	
May 19,	Oats ——	6 qrs.—	at	2	6	per buſhel
June 10,	Beans —	7 buſh.	at	4	6	———
July 12,	Bran ——	9 qrs.—	at	1	9	———
Aug. 17,	Tares —	14 buſh.	at	1	10	———
——26,	Peaſe —	18 ditto	at	3	9½	———
Sept. 12,	Pale malt	40 ditto	at	3	4	———

An Upholſterer's Bill.

Mr. Robert Ruſſel,

Bought of Charles Crofts and company,

1780,				l.	s.	d.	
May 9,	Superfine blankets	15 pr.	at	1	5	6	per pair
—— 16,	Medium ditto —	14 —	at	0	14	10	ditto
———	Harrateen blue —	40 ps.	at	0	2	6	pr p.
June 10,	Cheney ditto —	10 —	at	1	16	4	ditto
—— 24,	Green linſeys —	15 —	at	1	4	6	ditto
July 19,	12 printed callico quilts		at	0	18	0	each

A Silkman's

A Silkman's Bill.

Mrs. Helen Henry,
1780, Bought of William Weſt and partners,

March 18,	℔.		s.	d.	
For Tripoli belladine ſilk	50	at	17	10	per ℔.
April 19, Legee of Smyrna	24	at	15	6	ditto
——24, A fangot of raw ſilk	110	at	14	0	ditto
June 10, Do. of Ardas —	120	at	11	8	ditto
——19, Gold & ſilver twiſt	16	at	7	0	per Oz.
——— Twiſted ſilk in grain	14	at	3	6	ditto

An Ironmonger's Bill.

Mr. Robert Ralph,
1780, Bought of Samuel Smith,

May 12,			s.	d.	
For Spring door locks with hinges	20	at	4	6	each
July 19, Bolts 54 pounds ———		at	0	10	per ℔.
Aug. 11, Birmingham braſs locks	20	at	8	0	each
——19, A caſt iron back wt.	1 2 16	at	15	6	per H.
Sept. 11, Sheffield nails wt.	1 3 10	at	0	5	per ℔.
——17, Plate iron wt. ——	4 1 8	at	0	7	ditto

A Druggiſt's Bill.

Mr. Jacob Jones,
1780, Bought of Thomas Thrale,

June 16,	C.	℔.		l.	s.	d.	
For galls wt.	2 Gr.	17 Tr. ℔.	at	0	0	10	per ℔.
July 29, Meſtica cochineal		24	at	1	14	6	do.
Aug. 17, Scammony ———		14	at	0	9	0	do.
——22, Gum Arabic ——		110	at	0	0	9	do.
Sept. 3, Saſſafras —		4 hundred	at	0	0	4	do.
——28, Opium —		12 pounds	at	0	0	7	do.

A Tobacconiſt's

A Tobacconiſt's Bill.

Mr. George Grey,

Bought of William Wren,

		s.	d.
1780,			
March 24, For 2 hhds. of beſt bright tobacco qt. nt. 11 C.	at	0	9 per ℔.
June 12, 1 box of Oronooko qt. nt. 80 ℔. ——	at	1	0 ———
——20, 4 bags of old Spaniſh qt. nt. 510 ℔. ——	at	0	5 ———
July 28, 1 hhd.—qt. gr. 608 tr. 84 is nt. 524 ℔. —	at	0	6 ———
——30, 2 rolls qt. nt. 76	at	1	4 ———

BILLS of PARCELS, *uſed by Merchants, and Wholeſale Dealers.*

Mr. Francis Free, London, June 9, 1780.

Bought of Nathan Norton, 6 bales of French cloth, to pay at 9 months, as follows, *viz.*

				l.	s.	d.		l.	s.	d.
No. 1	qt.	2 ps. dowlas	at	4	10	0	per ps.	9	0	0
2		5 ps. ditto	at	5	0	0	ditto	25	0	0
3		6 ps. ditto	at	3	10	0	ditto	21	0	0
4		3 ps. lockrams	at	3	12	0	ditto	10	16	0
5		4 ps. ditto	at	2	10	0	ditto	10	0	0
6		7 ps. ditto	at	1	18	0	ditto	13	6	0
		27 ps. in all amounting to					— £.	89	2	0

Peter Pott, Eſq. Nov. 19, 1780.

Bought of Henry Holmes and partner, 8 bags of Farnham hops for ready money.

	C.	q.	℔.		
No. 1	2	3	12		
2	3	1	10		
3	2	3	10		
4	3	2	6		
5	2	3	4		
6	3	2	10		
7	2	3	20		
8	3	1	8		
	C. 25	0	24	at 1*s.* per pound	£.141 4 0

Mr. William Wynne, London, June 9, 1780.

Bought of Peter Pratt, 6 caſks of Barbadoes ſugar, at 3 months, *viz.*

	C.	q.	℔.				
1—wt.	6	1	24				
2	7	2	18				
3	8	3	10				
4	7	2	14				
5	6	1	26				
6	7	2	12				
Groſs	44	2	20				
Tare	3	2	4	*l.*	*s.*	*d.*	
Nett	41	0	16	at 2	16	0 per C.	115 4 0

		q.	℔.	
Tare		2	10	each
			6	multiply
C.	3	2	4	

The Form of a Bill of Lading.

SHipped by the Grace of God, in good order
and well-conditioned, by Thomas Traffic, of
London, merchant, in and upon the good ſhip
called the (Hopewell of London) whereof is maſter
under God for this preſent voyage (Samuel Seaman,
of London, mariner) and now riding at anchor in
(the port of London) and by God's grace bound
for (Cadiz) that is to ſay 1 (bale of broadcloth,
CD and 1 trunk, containing five hundred pair of ſilk
No. ſtockings, contents, &c. as per invoice) being
1,2 marked and numbered as per margin, and are to be
delivered in the like good order at the ſaid port of
(Cadiz) the danger of the ſeas only excepted, unto
(Mr. Peter Purchas, merchant there) or to his
aſſigns, he or they paying freight for the ſaid goods
(three pieces of eight per C. Wt.) with primage
and average accuſtomed. In witneſs whereof, the
ſaid maſter or purſer of the ſaid ſhip hath affirmed
to (three) bills of lading, all of this tenor and date,
one of which (three) bills being accompliſhed, the
other (two) to ſtand void. And ſo God ſend the
good ſhip to her deſired port in ſafety. *Amen.*

Dated in London, the 1ſt of June, 1780, inſides and contents unknown to

Samuel Seaman.

Note, The ſeveral words included in the parentheſis, are to be put into the ſeveral vacant places that are in a blank bill of lading.

Note alſo, Average is the general allowance made to the maſter of the ſhip, of 1d. or 2d. in every ſhilling freight; primage, a ſmall allowance to be diſtributed among the ſailors.

The Form of an Invoice.

Port-Royal in Jamaica, May 6, *Anno* 1780.

INVOICE of five Barrels of Indigo, five Hhds. of Sugar, and five Hhds. of Pimento, ſhipped on board the Adventure of London, Robert Rudder commander, for account and riſque of Timothy Tradewell, of London, merchant, being mark'd and number'd, as *per* Margin; contents, coſts and charges, as in the following Example.

viz.	Indigo 5 B	*l.*	*s.*	*d.*
I F				
No	143			
121	143			
to	146			
125	152			
	172			
	756 ℔. Nett, at 2*s.* 2*d.* per ℔.	81	18	—
	Sugar 5			
	Hhds. Tare			
	C.qr.℔. C.qr.℔. C.qr.℔.			
126	11-3-27—1-2-19 Groſs 68-0-00			
to	12-2-19—1-3-00 Tare 8-3-12			
130	13-2-13—1-2-16			
	14-1-15—1-3-11 Nett 59-0-19			
	15-1-10—1-3-22 at 24*s.* p. C.	70	19	5
	68-0-00—8-3-12			
	Pimento ℔.			
	5 Hhds Tare 1926 Groſs			
N	℔. ℔. 389 Tare			
131	332—84			
to	396—72 Nett 1537 at 11½*d.* per ℔.	73	12	11½
135	410—81			
	376—70 Charges			
	412—82 To Coſt of 5 Barrels and			
	10 Hhds. 4-7-9			
	1926—389 To Storage 1-0-0	5	7	9
		231	18	1½
	To Commiſſion at 5 p. C.	11	11	10¼
	Errors excepted *per A. B.*			

Buſineſs at the Waterſide, concerning exporting and importing of Goods, &c. Entering them at the Cuſtom-houſe, &c.

WHEN there are goods to export and ready packed, &c. there muſt be firſt made a bill of entry, (as it is called) of the contents, after this form, viz.

In the Happy Return, Stanley Stern; for St. Kitt's.
Thomas Traffic.
Four bales of Linen.
Six cheſts of Hardware.

Of theſe bills there muſt be ſeven, one of which muſt be in words at length, and the other may be expreſſed in figures: Theſe are by the clerks of the cuſtom-houſe entered into ſeveral books for that purpoſe. If ſome goods pay cuſtom, and others not, then there muſt be made two entries; one of thoſe that pay cuſtom, and another for thoſe that pay not; and likewiſe you muſt have two cockets.

A cocket teſtifies the payment of all duties; and is writ on a ſmall piece of parchment in the following words:

Know ye, that Thomas Traffic, *merchant, for four bales of Linen, and ſix cheſts of Hardware, in the Happy Return, Stanley Stern, for St. Kitt's, that he hath paid the duties. Dated May 4th,* 1780.

On the backſide of the cocket you muſt ſet down the marks, numbers, and quantity of the goods expreſſed in the inſide. When on clean paper you tranſcribe your bill of entry, upon which a ſhipping bill will be made out, on the back of this ſignify the marks, numbers, and contents, as before on the cocket; both which being thus endorſed, you are to deliver them to the ſearcher at the water-ſide, who depoſits them in the office till the going away of the ſhip, and then they are delivered to the captain or maſter of the ſhip.

If you have not judgment or experience enough to enter your goods yourſelf, it is but applying to any one of the clerks of the long-room, who make it there buſineſs. (and good buſineſs too) to enter people's goods; and for a ſhilling (you giving them the contents) they will write your bills and paſs your entries, without giving you any farther trouble, or your running the riſk of making any falſe entries, &c.

Entry Inwards.

THE ſhip being arrived, ſearch the entry-book in the long-room, and you will find the name of the ſhip and captain, as alſo the waiters that are to attend the delivery of the ſhip, and at what key the goods will be landed. The entry inwards runs thus:

In the Speedwell, Matthew Manſhip, from Barbadoes.

45 Hhds. of ſugar, &c.
64 Puncheons of Rum.

There muſt be eight of theſe bills, (though but ſeven outwards) and one of theſe muſt be in words at length (as well as one of the ſeven bills outwards) which is for the warrant of delivery, and muſt be ſigned by the perſon in whoſe name the goods were entered, and the mark alſo in the margin; which being done, and the fee for entry, and cuſtom paid, you will then have from the land-waiters a warrant for the landing and receiving your goods.

When goods are to be exported by certificate, viz. foreign goods formerly imported; theſe goods being to be ſent abroad, or exported to another place or country, by a native of England, within twelve, or a ſtranger within nine months after importation, entitle the exporter to a drawback of part of the cuſtom paid at the importation of the ſaid goods (producing a certificate from the Comptroller that they have paid the duties inwards.) And the debenture of cuſtom drawback runs thus:

Debenture.

TIMOTHY Tradewell, natural born, did, &c. make an entry with us of four thouſand ells of broad German linen, in the Dolphin, Captain Henry Hoare, for Barbadoes, the ſubſidy, &c. was paid inwards by, &c. as appears per certificate of the collector inwards: And for farther manifeſtation of his juſt dealing therein, he hath alſo taken oath before us of the ſame.

Cuſtom-Houſe, London, 4th June, 1780.

The Oath.

Jurat. T. T. That four thouſand ells of broad German linen, abovementioned, was really ſhipped out, and hath not been relanded in any port or creek in *England* or *Wales*, ſince laſt ſhipped, May 26, 1780.

The Certificate Cocket.

London: Know ye that T. T. for four thouſand ells of broad German linen, paid per, *&c.* the day, *&c.* laſt late unladen, and now in the *Dolphin*, Capt. *Henry Hoare*, for *Barbadoes*, Dated the 4th of June, 1780.

This Certificate Cocket is gained by applying to the books of the importer, to know the day, &c. when the cuſtom inwards was paid, and by whom; which carry to the long-room in the cuſtom-houſe, and deliver it to the comptroller's clerk of the ſubſidy inward and outward, with an account of what you would export, &c.

A little before was mentioned at what key the goods ſhould be landed, and therefore here it is proper to name the keys (or rather Quays) and wharfs that goods are uſually landed at, which are theſe, *viz.*

Somer's key, Smart's key, Wiggin's key, Bear key, Dice key, Cuſtom-houſe key, Potter's key, Wool key, Galley key, Brewer's key, Ralph's key, Cheſter's key, Lyon's key, Cox's key, Hammond's, Young's and Gaunt's keys. And the wharfs are freſh wharf and Botolph wharf.

Beſides theſe, there are certain places called Docks, which are harbours cut into the land, where there is no current, but only a flow and ebb, occaſioned by the riſe and fall of the tide in the river Thames; and theſe are convenient for the lying of veſſels, hoys, lighters, barges, and boats; and are theſe, *viz.*

Billingſgate dock, Sabb's dock, Tower dock, St. Catharine's dock, Wapping dock, Hermitage dock, Execution dock, and Limehouſe dock. And above bridge, Queenhithe dock, Puddle dock, White Friars dock, and Scotland-Yard dock. And upon Southwark or Surry ſide, are Saviour's dock, below the Bridge-Yard, and ſeveral others for private uſes. But more particularly eminent on that ſide of the water, is the Bridge Yard for landing ſundry ſorts of merchandizes, but chiefly from the ports of England.

Of Wharfage and Lighterage.

WHARFINGERS have ſeveral managers over them, and alſo a committtee to redreſs grievances, &c. and clerks of the ſtations, with lighter managers, and have the letting of many warehouſes (which are now very fine and commodious, being rebuilt ſince the ſad fire in Thames-ſtreet) cellars, &c. and have the privilege of keeping lighters for the carriage of goods to and from ſhips.

The Rates of Wharfage.

Are generally computed at 12*d.* per ton, whether outward or inward; excepting ſugar from the Weſt Indies which pays 2*s.* per ton, 4 hhds. being accounted a ton (though they weigh more) Crainage is included in the 12*d.* per ton wharfage, and for lighterage, the wharfingers have 12*d.* for 4 hogſheads of ſugar that comes from the Weſt-Indies; and for wine and other goods the lighterage is half as much as the wharfage.

Of

Of ARITHMETIC.

HAVING thus given the reader a tolerable notion of the different forms of receipts, notes, bills of parcels, &c. to be uſed in buſineſs; We ſhall next proceed to Arithmetic, the knowledge of which is ſo indiſpenſably neceſſary, not only in trade, but in almoſt all the common affairs of life.

And firſt of Notation and Numeration.

In Notation we muſt obſerve, that all numbers are generally expreſſed by the ten characters following, *viz.*

One,	*Two,*	*Three,*	*Four,*	*Five,*	*Six,*	*Seven,*	*Eight,*	*Nine,*	*Cypher.*
1	2	3	4	5	6	7	8	9	0

Nine of theſe are called ſignificant figures, to diſtinguiſh them from the cypher, which of itſelf ſignifies nothing; but, as it is placed, it ſerves to increaſe the value of the next figure or figures that ſtand before it; as 4 is but four; but before the cypher thus, 40, the 4 becomes forty, &c.——We are to note, that every one of the above nine figures or digits, has two values; one certain, and another uncertain, the certain value is, when it ſtands alone by itſelf; the uncertain is, when joined or placed with other figures or cyphers; for, when any one of theſe figures ſtands alone, it ſignifies no more than its own ſimple value; as 2 is but two, 3 but three, 4 but four, and 5 no more than five, &c. And this is the certain value of a figure; but, when another figure or cypher is annexed, they are then encreaſed in their value ten times: as 2, or 2 units, or ones, or 2 tens, or twenty, 3 to 3 tens or thirty, 4 to 4 tens or forty, and 5 to 5 tens or fifty; as thus, 21, twenty-one; 32, thirty-two; 43, forty-three; 54, fifty-four, &c. Again, if any of the ſaid figures ſtand in the third place towards the left-hand, they then ſignify ſo many hundreds as ſingly they expreſs units or ones; as 200 is two hundred, 300 three hundred, 400 four hundred, 500 five hundred, &c. If any of them poſſeſs the 4th place towards the left hand, they are ſo many thouſands as they contain units: And ſo any, or every figure, increaſes by a tenfold proportion, from the right-hand to the left, according to the place it ſtands in; ſo that two may be but two, or twenty; two hundred, or two thouſand. In the firſt place, 2; in the ſecond 20; in the third 200; and in the fourth place, 2000, &c. This therefore is the uncertain value of a figure; But the true value of figures in conjunction may be fully learnt and underſtood by the following table.

The Numeration Table.

C Thouſ. of M.	X Thouſ. of M.	Thouſ. of Mill.	C of Millions	Tens of Millions	Millions	C of Thouſands	Tens of Thouſ.	Thouſands	Hundreds	Tens	Units
12	11	10	9	8	7	6	5	4	3	2	1
1	2	3	4	5	6	7	8	9	0	1	2
	1	2	3	4	5	6	7	8	9	0	1
		1	2	3	4	5	6	7	8	9	0
			1	2	3	4	5	6	7	8	9
				1	2	3	4	5	6	7	8
					1	2	3	4	5	6	7
						1	2	3	4	5	6
							1	2	3	4	5
								1	2	3	4
									1	2	3
										1	2
											1

Thouſands of Millions.	Millions	Thouſands	Units or Ones
123	456	789	012
12	345	678	901
1	234	567	890
	123	456	789
	12	345	678
	1	234	567
		123	456
		12	345
		1	234
			123
			12
			1

In order to read any number with eaſe and exactneſs, get the words at the head of the table by heart; as units, tens, hundreds, thouſands, &c. and apply them thus; 56, ſix units, ſix, and 5 tens, fifty, that is, fifty-ſix. Again, 456; 6 units, ſix; 5 tens, fifty, and 4 hundreds, four hundred; that is, four hundred and fifty-ſix. One more, 3456; 6 units, ſix; 5 tens, fifty; 4 hundreds, four hundred; 3 thouſands, three thouſand; therefore the ſum together is, three thouſand four hundred fifty-ſix. Read the 4th line from the top, *viz.* 123456789; here the valuation of the figures is from the right-hand to the left, as 1 in the ninth is hundreds of millions, but to be read from the left-hand to the right; thus, one hundred twenty-three millions, four hundred fifty-ſix thouſand, ſeven hundred eighty-nine. But any number may be read yet more intelligibly, *viz.* by ſtops, thus; make a comma after every third figure or cypher, beginning at the right-hand, and proceeding on towards the left; diſtinguiſhing thereby every third place into hundreds, as hundreds of units, hundreds of thouſands, hundreds of millions, and hundred thouſands of millions, &c. Let us, for example, read the firſt line of the table; the laſt place in valuation is hundred thouſands of millions, and to be pointed into diviſions thus, 123,456,789,012; and read as follows, one hundred twenty-three thouſand, four hundred fifty-ſix millions, ſeven hundred eighty-nine thouſand, and twelve: that is, no hundreds, but twelve. Again, read the following number, *viz.* 276,245,678,921,460; here the firſt point or period is betwixt 4 and 1, and the laſt between 2 and 6, and to be read thus; 276 millions of millions, 245 thouſands of millions, 678 millions, 921 thouſands, 460 units or ones. The foregoing Table of Numeration is on the right-hand divided into periods, for the eaſier reading thereof; and the like is frequently done in the exchequer, bank, lottery tickets, &c.

Numbers to be read or written.

96, Ninety-ſix
242, Two hundred forty-two
7924, Seven thouſand nine hundred 24
54006, Fifty-four thouſand and ſix
524707, Five hundred twenty-four thouſand 707
4606240, Four milllions 606 thouſand 240
62700471, Sixty-two millions 700 thouſand 471
474960204, Four hundred 74 millions 960 thouſand 204
4214007042, Four thouſand 214 millions 7 thouſand 42
470706420042, Four hundred and 70 thouſand 706 millions 420 thouſand and 42

Of Numerical Letters.

Sometimes numbers are expreſſed by letters; eſpecially in the *Bible*, to ſignify the chapter or pſalm; at the bottom of title pages of books, for the date of the year, and frequently in inſcriptions on funeral monuments, &c. For which reaſon 'tis neceſſary to know how to read them. Therefore obſerve, that I. ſtands for 1. or an unit, II. for 2. III. for 3. IV. for 4. V. for 5. VI. for 6. VII. for 7. VIII. for 8. IX. for 9. X. for 10. XI. for 11. XII. for 12. XIII. for 13. XIV. for 14. XV. for 15. XVI. for 16. XVII. for 17. XVIII. for 18. XIX. for 19. XX. for 20. XXI. for 21, &c. XXX. for 30. XXXI. for 31, &c. XL. for 40. XLV. for 45, &c. L. for 50. LI. for 51, &c. LX. for 60. LXI. for 61, &c. LXX. for 70. LXXI. for 71, &c. LXXX. for 80. LXXXI. for 81, &c. XC. for 90. XCI. for 91, &c. C. for 100. CC. for 200. CCC. for 300. CCCC. for 400. D. or IↃ. for 500. DC. for 600, &c. M. or CIↃ. for 1000, &c. Thus the year 1780 is wrote MDCCLXXX.

When a letter of inferior value ſtands after one of ſuperior, its value is to be added thereto; thus, VI, VII, and VIII, ſignify ſix, ſeven, and eight. But when a letter of inferior value is placed before one of ſuperior, then its value is to be taken therefrom: thus, IV, IX, XL. and XC, ſignify four, nine, forty and ninety.

ADDITION.

IS the putting together two or more numbers or ſums, ſo that their total value may be diſcovered or known.

Here we muſt always obſerve to ſet the numbers to be added, orderly one under the other; that is, units under units, tens, under tens, hundreds under hundred, &c. as in the ſubſequent examples.

Addition of Numbers of one Denomination.

Yards.

	Tens	Units
	2	4
	4	2
	6	8
	8	6
	2	4
	4	2
2	8	6

Gallons.

	Hund.	Tens	Units
	7	5	6
	4	3	2
	5	7	8
	6	9	6
	4	2	2
	6	7	8
3	5	6	2

Pounds.

	X of Th.	Thouſ.	Hund.	Tens	Units
	5	7	9	6	2
	3	9	7	4	4
	6	7	2	2	2
	7	9	6	7	4
	.	2	4	9	2
	.	.	3	9	0
2	4	7	4	8	4

In addition of ſimple numbers, whether it be yards, gallons, pounds, or any thing elſe, remember to carry 1, for every 10 you find in the row or rank of figures being unites, to the next row of tens; and the like from the rank of tens to the row of hundreds, &c. and whatever it makes in the laſt row, you muſt ſet it down, amount to what it will. Thus:

The numbers above are ſet down in order, as before directed; that is, units under units, tens under tens, &c. as may be plainly underſtood, by being indicated at the head of each row or rank by units, tens, hundreds, &c. Then in caſting up each example, to know its total, I begin at the right hand, or units rank, of the firſt example, and ſay 2 and 4 is 6, and 6 is 12, and 8 is 20, and 2 is 22, and 4 is 26; in which row there are two tens and 6 over; wherefore I ſet down 6 juſt under its own rank, and carry two to the next row, and ſay, 2 that I carry and 4 makes 6, and 2 is 8, and 8 is 16, and 6 is 22, and 4 is 26, and 2 is 28; and this being the laſt row, I ſet down the amount, *viz.* 28; ſo that the total number of yards is found to be 286. And the amount of the next or ſecond example, is found by the ſame method to be 3562 gallons. And, in the third and laſt example, the total number of pounds is found to be 247484. And ſo the total of any other example of the ſame kind, *viz.* ſimple numbers of one denomination, may be found. *Note,* That when any of the ranks amount to juſt 10, 20, 30, 50, &c. then you muſt ſet down the 0 under its proper rank, and carry either 1, 2, 3, 4, or 5, according to the number of tens that you find, to the next row. This you muſt always do in every row but the laſt, where the whole amount muſt be ſet down without any reſerve or carriage in the mind, becauſe there is no other row or rank to carry to, as was hinted before.

Addition of mix'd Numbers.

Note, 4 fathings make 1 penny; 12 pence make 1 ſhilling; 20 ſhillings make 1 pound ſterling.

Libra in Latin ſignifies a pound; *l.* therefore ſtands for pounds.

Solidus in Latin ſignifies a ſhilling; *s.* therefore ſtands for ſhillings.

Denarius in Latin ſignifies a penny; *d.* therefore ſtands for pence.

Quadrans in Latin ſignifies a farthing; *q.* therefore ſtands for farthings.

Obſerve, that pounds be ſet directly under pounds, ſhillings under ſhillings, pence under pence, and farthings under farthings.

But, before you proceed, get this Table of Pence by heart; thus, 30*d.* is half a crown, then 60*d.* is 5*s.* Again, 40*d.* is 3*s.* 4*d.* then 80*d.* is 6*s.* 8*d.* Again, 50*d.* is 4*s* 2*d.* then 100*d.* is 8*s.* 4*d.* &c.

d.		*s.*	*d.*	*s.*		*l.*	*s.*
20	is	1	8	20	is	1	0
30	——	2	6	30	——	1	10
40	——	3	4	40	——	2	0
50	——	4	2	50	——	2	10
60	——	5	0	60	——	3	0
70	——	5	10	70	——	3	10
80	——	6	8	80	——	4	0
90	——	7	6	90	——	4	10
100	——	8	4	100	——	5	0
110	——	9	2	110	——	5	10
120	——	10	0	120	——	6	0

The uſe of theſe Tables is this: whenever you are caſting up any ſum of money, you begin at the right-hand (as before in ſums of one denomination) ſuppoſe at the place of pence, then if the rank, row, or denomination of pence amounts, from the bottom to the top, to 56; your table of pence tells you, that 50*d.* is 4*s.* and 2*d.* to which adding 6*d.* the ſum is 4*s.* 8*d.* If to 92*d.* the table tells you, that 90*d.* is 7*s.* 6*d.* which with 2*d.* over is 7*s.* 8d. And if to 81*d.* the table ſhews that 80*d.* is 6*s* 8*d.* and 1*d.* more makes 6*s.* 9*d.* &c.

The Shilling table ſerves to lead you to a quick recollection, how many pounds there are to ſo many ſhillings; as admit the rank of ſhillings ariſes to 57*s.* the table ſays that 50*s.* is 2*l.* 10*s.* and 7*s.* over make 2*l.* 17*s.* If to 84*s.* the table declares, that 80*s.* is juſt 4*l.* and 4*s.* over, make 4*l.* 4*s.* If to 112*s.* the table tells you that 100*s.* is 5*l.* and 12*s.* make 5*l.* 12*s.* &c.

Addition of Money.

Money owing, and Money received as follows:

(1)

Ow. to	Mr. Adams	4	12	6
	Mr. Brett	7	06	9
	Mr. Cuſt	4	12	0
	Mr. Dow	6	17	7
	Mr. Eaton	5	06	6
	Mr. Franks	4	12	3
	Mr. Green	6	00	0
	Mr. Hunt	5	15	4
		45	02	11

(2)

Rec. for	Tobacco	46	10	9
	Sugar	79	16	0
	Indigo	42	18	3
	Broad cloth	66	12	4
	Canary	90	16	0
	Port wine	84	07	6
	Rice	24	12	0
	Logwood	60	10	0
		496	02	10

I begin with the right-hand rank, that is the pence in the example of money owing, and ſay 4 and 3 is 7, and 6 is 13, and 7 is 20, and 9 is 29, and 6 makes 35 pence; now 30 pence, according to the table, is 2*s.* 6*d.* and 5*d.* more makes 2*s.* and 11*d.* I ſet down 11 exactly under the rank of pence, and ſay, 2 ſhillings that I carry (which I do to the rank of ſhillings) and 5 is 7, and 2 is 9, (for I take firſt only the units rank of ſhillings) and 6 is 15, and 7 makes 22, and 2 is 24, and 6 is 30, and 2 makes 32: and now being come to the top of the ſum, and it making 32, I come down with the tens of ſhillings, ſaying 32 and 10 is 42, and 10 is 52, and 10 is 62, and 10 is 72, and 10 makes 82 ſhillings; and the table telling me that 80 ſhillings is 4 pounds, I know therefore 82*s.* is 4*l.* 2s. wherefore I ſet down the odd 2*s.* juſt under the row of ſhillings, and carry 4 pounds to the pounds; ſaying 4 that I carry and 5 is 9, and 6 is 15, and 4 is 19, and 5 is 24, and 6 is 30, and 4 is 34, and 7 is 41, and 4 makes 45 pounds; ſo that the total of thoſe ſeveral ſums of money, due to the ſeveral perſons, amount to 45*l.* 2*s.* 11d.

In the example of money received, I begin at the right-hand rank as before, and ſay 6 and 4 is 10, and 3 is 13, and 9 makes 22, and 22 pence being 1*s.* 10*d.* I ſet down 10 and carry 1*s.* to the ſhillings; ſaying 1 that I carry and 2 is 3, and 7 is 10, and 6 is 16, and 2 is 18, and 8 is 26, and 6 makes 32; then I come down with the tens, ſaying, 32 and 10 makes 42, &c. and find at the bottom it comes to 102 ſhillings, which makes 5*l.* 2*s.* I ſet down 2*s.* and carry 5*l.* to the pounds; ſaying, 5 that I carry and 4 is 9, &c. I find that at the top it amounts to 56, whereof I ſet down 6 exactly under its own rank, *viz.* the rank of units of pounds, and carry 3 for 3 tens that are in 30; for at all times in the addition of the left-hand denomination, whether it be money, weight, or meaſure, that is, in the denomination of pounds, tons, or yards, you muſt for every ten carry one to the next row, &c. ſaying, 3 that I carry, and 6 is 9, and 2 is 11, and 8 is 19, &c. and I find that at the top it come to 49, &c. wherefore I ſet down 49 to the left-hand of the 6; and the total amount of the money received for thoſe particular goods or wares ſold is 496*l.* 2*s.* 10*d.*

More Examples for Practice.

l.	*s.*	*d.*	*l.*	*s.*	*d.*	*l.*	*s.*	*d.*
17	12	6¼	146	12	3¼	4	10	6
26	10	2	287	10	9	0	07	9
50	00	0	46	16	6	1	00	0
44	12	8½	100	00	0	1	01	0
60	14	0	72	12	4	0	04	6
29	16	6¾	69	16	6¾	0	10	0
16	10	0	460	12	9	4	14	4
20	00	0	49	10	0	0	07	6
27	11	4½	7	12	4¼	0	01	6
17	04	0	22	10	0	0	02	6
20	10	3	164	12	9	3	10	9
46	16	0	75	10	6	1	10	0
377	17	7	1503	16	9¼	18	00	4

Addition of Avoirdupois.

By this weight are weighed all kinds of grocery goods or wares, or goods ſubject to waſte; as tobacco, ſugars, fruit and drugs; as alſo fleſh, butter, cheeſe, allum, tallow, iron, braſs, copper, lead, tin, pewter, pitch, tar, roſin, hemp, flax, ſoap, ſalt, *&c.*

A table of this Weight is as follows, &c.

4	Quarters make 1 dram, marked	*qr.*
16	Drams 1 ounce	*oz.*
16	Ounces 1 pound	*lb.*
28	Pounds 1 quarter of a hundred. weight, 112 pounds	*qrs.*
4	Quarters 1 hundred weight	*C.*
20	Hundred weight 1 ton	*T.*

	4	28	10	4	28		4	28	10	16	16
C.	*qrs.*	*lb.*	*C.*	*qrs.*	*lb.*	*C.*	*qrs.*	*lb.*	*lb.*	*oz.*	*dr.*
5	1	16—	24	1	12	9	1	16	24	11	12
4	2	24—	42	2	00	4	3	26	42	14	15
6	3	06—	16	1	12	7	1	00	64	10	11
7	1	12—	25	3	24	5	3	27	29	09	10
9	0	20—	19	0	20	4	3	02	16	12	13
6	2	00—	26	1	22	2	2	02	27	13	14
39	3	22	154	3	06	34	3	17	206	09	11

In theſe examples, the manner of proceeding is the ſame as in the former, obſerving that the number of units of each leſſer denomination, which make an unit of the next greater, found by the preceding table, is placed above each rank of number; that is to ſay, in the firſt example, 28 the number of pounds contained in a quarter of an hundred weight, is placed over the column of pounds; now that column, when added up, makes 78, which contains two 28's and 22 over, wherefore I ſet down 22 under the column of pounds, and carry 2 to the column of quarters, and ſo on.

Note, That in weighing at the water-ſide, or elſewhere, they do not weigh by the ton, though ſome goods are ſold by it, as iron, logwood, cheeſe, &c. but by the hundred, quarters, and pounds, which are afterwards reduced to and computed by tons.

Addition of Troy Weight.

By this weight are weighed jewels, gold, ſilver, pearls, and medicines, and the uſual denominations are pounds, ounces, penny-weights, and grains, as in the following table, *viz.*

24 Grains make 1 Penny-weight,
20 Penny-weights 1 Ounce, and
12 Ounces 1 Pound Troy:

Examples of Troy Weight.

6 Ingots of Silv. wt. *viz.*						10	12	20	24	12	20	24
No.		*lb.*	*oz.*	*pw.*	*gr.*	*lb.*	*oz.*	*pw.*	*gr.*	*oz.*	*pw.*	*gr.*
1	Wt.	4	05	12	10	14	06	10	11	204	10	14
2		5	04	16	17	24	10	11	12	96	07	17
3		3	11	19	20	21	06	04	17	100	11	12
4		4	06	07	12	22	10	12	14	56	16	20
5		5	01	11	12	16	11	12	13	212	10	23
6		4	11	12	13	21	07	99	17	96	19	12
		28	06	00	12	122	05	01	12	767	17	02

If what was before ſaid be duly obſerved, the performance of the above examples will be attended with no difficulty.

How to prove Addition.

IN all additions, whether of ſimple numbers, that is, numbers of one denomination, or in examples compound, that is of divers denominations, as pounds, ſhillings, pence, and farthings, &c. the readieſt method of proof is to caſt the ſum downwards (beginning at the top as you did the ſame upwards, beginning at the bottom) and if that operation produces the ſame total, the work is certainly right; and this is much better, and more ſenſible than the common method uſed in ſchools, of making two totals, by omitting the upper line in the ſecond. I might here, alſo give ſeveral examples of other additions, ſuch as apothecaries weight, cloth, liquid, dry and long meaſures, time, &c. but the ſame method ſerves for any of them, having reſpect to the tables belonging to thoſe ſeveral denominations, which are as follow, &c.

A Table of the Parts of Apothecaries Weight.

20 Grains	1 Scruple	℈	a Scruple.
3 Scruples	1 Dram	ʒ	a Dram.
8 Drams	1 Ounce	℥	an Ounce.
12 Ounces	1 Pound	℔	Pound.

By theſe weights they compound their medicines; but they buy and ſell their Drugs by Avoirdupois weight.

Cloth Meaſure.

4 Nails, or 9 Inches,	1 Qr. of a Yard.
4 Qrs. or 36 Inches,	1 Yard.
5 Qrs. or 45 Inches,	1 Ell Engliſh.
3 Qrs. or 27 Inches,	1 Ell Flemiſh.
6 Qrs. or 54 Inches,	1 French Ell.

A Table of Wool Weight.

Note, 7 ℔. make 1 clove; 2 cloves, or 14 ℔. 1 ſtone; 2 ſtones, or 28 ℔. 1 todd; 6 todd and ½, 1 wey, or 182 ℔. 2 weys, or 364 ℔. 1 ſack; and 12 ſacks 1 laſt, or 4368 ℔. 240 ℔. 1 pack of wool.

Note, that 1 ℔. 2 oz. 12 pw. Troy, is equal to a pound Avoirdupois. And a pound Troy, is about 13 oz. 2 drams and a half Avoirdupois.

A pound weight Troy	of ſilver	3	02	2
A pound wt. Avoirdupois	is worth	4	15	3½

100*l.*	in gold	weighs	1	11¾	*Avoi. wts*
	in ſilver		26	04	

A pound Avoirdupois is heavier than a pound Troy; but an ounce Troy is heavier than an ounce Avoirdupois.

A Table of Liquid Meaſure.

Liquid meaſure is of two ſorts, *viz.* one for wine, brandy, &c. and the other for beer and ale.

Wine Meaſure, &c.

8 Pints 1 Gallon.
42 Gallons 1 Tierce.
63 Gallons 1 Hogſhead.
84 Gallons 1 Puncheon.
2 Hogſheads 1 pipe or Butt.
2 Pipes or Butts 1 Tun, or 252 Gallons.

Note, That ſweet oil hath 236 gallons to the tun; but oil from Greenland hath 252 gallons to the tun.

Note, The wine gallon contains 231 cubic or ſolid inches, by which all liquids are meaſured, except beer and ale.

Beer Meaſure.

8 Pints 1 gallon
9 Gallons 1 firkin
2 Firkins 1 kilderkin

2 Kilderkins 1 barrel, or 36 gallons
1 Barrel and half, 54 gallons, 1 hogſhead.

Ale Meaſure.

8 Pints 1 gallon
8 Gallons 1 firkin ſoap, or herrings
2 Firkins 1 kilderkin

2 Kilderkins 1 barrel, or 32 gallons
1 Barrel and half, or 48 gallons, 1 hogſhead.

Note, The Beer and Ale gallon are the ſame, *viz.* 282 ſolid inches; but the barrel of beer contains 1228 cubic inches, or 4 gallons more than the barrel of ale.

In a Tun of Wine are
2 Pipes or butts
6 Tierces
252 Gallons
504 Pottles
1008 Quarts
2016 Pints.

In a Pipe or Butt are
2 Hogſheads
3 Tierces
126 Gallons
252 Pottles
504 Quarts
1008 Pints.

In a Puncheon are
84 Gallons
168 Pottles
336 Quarts
672 Pints.

In a Barrel of Beer are
2 Kilderkins
4 Firkins
30 Gallons
72 Pottles
144 Quarts
288 Pints.

In a Hogſhead are

63	Gallons
126	Pottles
252	Quarts
504	Pints.

In a Barrel of Ale are

2	Kilderkins
4	Firkins
32	Gallons
64	Pottles
128	Quarts
256	Pints.

Dry Meaſure.

2 Pints 1 quart
2 Quarts 1 pottle
2 Pottles 1 gallon
2 Gallons 1 peck
4 Pecks 1 buſhel dry meaſure
5 Pecks 1 buſhel water meaſure
4 Buſhels 1 comb, or half-quarter
2 Combs 1 quarter
4 Quarters 1 chaldron
5 Quarters 1 wey
2 Weys 1 laſt or 10 quarts
4 Fatts, or vatts, or 36 buſhels of ſea-coal, 1 chaldron; and 21 chaldrons is accounted a ſcore in the river Thames.

Salt and ſea-coal are heaped, or elſe there are 5 pecks to the buſhel.

In the Laſt are

2	Weys
10	Quarters
80	Buſhels
320	Pecks
1280	Pottles
2560	Quarts
5120	Pints.

In a Wey are

5	Quarters
40	Buſhels
160	Pecks
320	Gallons
640	Pottles
1280	Quarts
2560	Pints.

Note, By an act, Anno 1712, the buſhel is 2178 cubic inches, and a gallon of this meaſure is 272¼ cubic inches.

Long Meaſure.

8	Barley-corns 1 inch
12	Inches 1 foot
3	Feet 1 yard
3	Feet 9 inches 1 ell Eng.
5	Feet a geometrical pace
5	Yards and a half, 1 pole, perch, or rod.
6	Feet 1 fathom, or 2 yds.
40	Poles, or 220 yards, 1 furlong
8	Furlongs 1 mile, or 1760 yards
3	Miles 1 league.

In a Mile are

8	Furlongs
320	Poles
1760	Yards
5280	Feet
63360	Inches
190030	Barley-corns.

Land Meaſure.

5 Yards and a half, 1 pole, perch, or rod.
40 Poles make 1 rood, or quarter of an acre.
160 Poles in length, and 1 in breadth, is 1 acre.
80 Poles in length, and 2 in breadth, 1 acre; and
40 Poles in length, and 4 in breadth, 1 acre.
4 Poles in length make 1 chain.
10 Chains in length, and 1 in breadth, make 1 acre.

Time.

60	Seconds 1 minute
60	Minutes 1 hour
24	Hours 1 natural day.
7	Days 1 week
4	Weeks 1 month
13	Months, 1 day, and 6 hours, 1 common year.

In a Year are

31557600	Seconds
525960	Minutes
8766	Hours
365	Days 6 hours.

Note, The year is divided into 12 calendar months, which contain 365 days, according to this good old diſtich, *viz.*

Thirty Days hath September, April, June *and* November,
February *hath* 28 *alone, and all the reſt have Thirty-one.*

SUBTRACTION.

THE next Rule in Arithmetic is Subtraction, which takes a leſſer number from a greater, and leaves the difference.

In order to perform the operations in this rule aright, you muſt place the leſſer number under the greater (with the ſame care, and in the ſame order as in addition) and draw a line under them, and beginning at the right-hand, take each figure in the lower line from the figure under which it ſtands; but if the figure in the lower line is greater than that in the upper, then in numbers of one denomination, ten muſt be borrowed and added to the figure in the upper line; then take the figure in the lower line from the ſum, and write down the remainder; but for every ten thus borrowed, one muſt be paid or added to the next left-hand figure in the lower line. *Example*; ſuppoſe Mr. *Adam* owes Mr. *Brown*
323*l.* whereof Mr. A. hath paid to Mr. B. the ſum of
146*l.* in part; what remains due to Mr. Brown?
—— Anſwer, 177*l.*
177*l.*

Here the leſſer number 146 ſtands under the greater 323; and to find the remainder, or ſum remaining due, I ſay 6 from 3 I cannot, but 6 from 13 (for you borrow 10 and add it to the figure or cypher that ſtands directly over the figure you ſubtract) and there remains 7; then 1 that I borrowed and 4 is five, for as I borrowed 10 in the inferior place, which is equal to one in the ſuperior, ſo I muſt now pay the ſame; therefore I ſay, 5 from 2 I cannot, but 5 from 12 (borrowing 10, and adding it to the figure 2, as above directed) and there remains 7; then 1 that I borrowed and 1 is 2, from 3 the figure above it, and there remains

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12 Inches 1 foot
3 Feet 1 yard
3 Feet 9 inches 1 ell Eng.
5 Feet a geometrical pace
5 Yards and a half, 1 pole, perch, or rod.
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4 Poles in length make 1 chain.
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60 Minutes 1 hour
24 Hours 1 natural day.
7 Days 1 week
4 Weeks 1 month
13 Months, 1 day, and 6 hours, 1 common year.

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525960 Minutes
8766 Hours
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323*l.* whereof Mr. A. hath paid to Mr. B. the ſum of
146*l.* in part; what remains due to Mr. Brown?
—— Anſwer, 177*l.*
177*l.*

Here the leſſer number 146 ſtands under the greater 323; and to find the remainder, or ſum remaining due, I ſay 6 from 3 I cannot, but 6 from 13 (for you borrow 10 and add it to the figure or cypher that ſtands directly over the figure you ſubtract) and there remains 7; then 1 that I borrowed and 4 is five, for as I borrowed 10 in the inferior place, which is equal to one in the ſuperior, ſo I muſt now pay the ſame; therefore I ſay, 5 from 2 I cannot, but 5 from 12 (borrowing 10, and adding it to the figure 2, as above directed) and there remains 7; then 1 that I borrowed and 1 is 2, from 3 the figure above it, and there remains 1, and ſo the queſtion is done; and by it is ſhewn that A ſtill owes B. 177 pounds. To prove that is right, add 177 the remainder, to 146, the leſſer of the two given numbers, and it will make 323, which is the ſame with the greater number, or ſum of money firſt due; and conſequently is a ſure proof of the certainty of the rule. And as Subtraction is proved by Addition, ſo may Addition be proved by Subtraction; for if the two aforeſaid numbers, *viz*, 323 and 146, are added, their total is 469; from which if you deduct 146, the remainder will be the greater number; or if you ſubtract 323 from the ſaid 469, the remainder will be 146 the leſſer number.

All queſtions in Subtraction of numbers of one denomination are performed as above. However the better to illuſtrate the rule, I ſhall give a few more examples. Suppoſe a great ſheep-maſter hath in all 6904 ſheep, and takes out of them 2490 to diſpoſe of at market, how many doth he leave behind? To know this ſet them down thus:

From—6904 the greater number,
Take—2490 the leſſer number.

Anſwer 4414

Here I ſay 0 from 4 and there remains 4; then 9 from nothing (or 0) I cannot; but 9 from 10 (adding 10 to the 0) and there remains 1; and 1 that I borrowed and 4 makes 5, and 5 from 9 and there remains 4; and laſtly, 2 from 6 and there remains alſo 4 (for I borrowed none, and therefore there is no occaſion of paying) ſo that he leaves behind him juſt 4414; which put to the number he takes to market, makes the number he had, *viz.* 6904, and ſhews the deduction to be true, and the anſwer right.

More

More Examples for Practice.

	Pounds.	Yards.	Gallons.	Buſhels.
From	6274	7328	56789	827493
Take	4985	5167	37894	238514
Rem.	1289	2161	18895	588979
Proof	6274	7328	56789	827493

The diſtance of time ſince any remarkable event, may be found by ſubtracting the date thereof from the preſent year.

Examples.

I.——1780
1066 The Conqueſt.
714 Years ſince

II.—1780
1535 The Reformation
245 Years ſince.

III.—1780
1688 The Revolution
92 Years ſince.

Subtraction of Divers Denominations.

Here, if the figure or figures, placed in the lower line, exceed thoſe in the upper, then as many units muſt be borrowed, as make a unit, or one, of the next ſuperior denomination; and one muſt be carried to the next left-hand place in the lower line, as before.

Of Money.

	l.	*s.*	*d*
Due——	9	02	6
Paid——	6	16	4
Reſts due	2	06	2

Suppoſe Mr. Cuſt owes Mr. Day, 9*l.* 2*s.* 6*d.* and Mr. C. hath paid Mr. D. in part, 6*l.* 16*s.* 4*d.* what remains due to Mr. Day? Anſwer, there is due to Mr. Day 2*l.* 6*s.* 2*d.*

	10	20	12 4
	l.	*s.*	*d.*
Sold for —	242	16	3¾
Paid in part	174	12	6½
Anſwer——	68	03	9¼

Again, Mr. Elliot ſells to Mr Froſt, Spaniſh Wool, to the value of 242*l.* 16*s.* 3¾*d,* and pays preſent money the ſum of 174*l.* 12*s.* 6½*d.* what money remains unpaid from Mr. Froſt? Anſwer, 68*l.* 3*s.* 8¼*d.*

In the firſt of theſe examples I ſay, 4*d.* from 6*d.* and there remains 2*d.* then 16*s.* from 2*s.* I cannot, but borrowing one integer of the next denomination, or 1 pound, which is 20*s,* I ſay 16 from 20, and there reſts 4, and adding thereto the number 2 it makes 6; wherefore I put down 6 in the place of ſhillings, and ſay, 1 that I borrowed and 6 is 7; now 7l. from 9*l.* there remains 2*l.* ſo the money reſting due to Mr. Day, is 2*l.* 6*s.* 2*d.* as in the example.

In the ſecond example, I ſay, 2 farthings (or an half-penny) from 3 farthings, and there remains 1 or ¼, which I ſet down in its proper place, *viz.* under the denomination of farthings; then 6 from 3 I cannot, but 6 from 12 (as marked over the denomination) and there remains 6, and 3*d.* over it makes 9*d.* which I place under the line in its right place, *viz.* of pence; then 1 that I borrowed (that is 1 ſhilling) and 12 is 13; 13*s.* from 16*s.* and there reſts 3, which I likewiſe ſet down under its own rank; then 4 from 2 I cannot, but 4 from 12, (borrowing 10) and there reſts 8; then 1 that I borrowed and 7 makes 8; 8 from 4 I cannot, but

8 from 14, and there remains 6; and 1 that I borrowed and 1 makes 2; 2 from 2 and there remains nothing; ſo that the ſum remaining due is 68*l.* 3*s.* 9¼*d.* as in the work. For its proof, you muſt add the remainder, 68*l.* 3*s.* 9¼*d,* to the leſſer or under ſum, 174*l.* 12*s.* 6½*d,* and it makes 242*l.* 16*s.* 3¾d, the ſum firſt due, which ſhews the work to be right.

More Examples for Practice.

	10	20	12 4	10	20	12	10	20	1
	l.	*s.*	*d.*	*l.*	*s.*	*d.*	*l.*	*s.*	*d.*
Due——	174	16	6¼	74	10	4	2471	07	0
Paid——	97	12	4¾	29	12	9	1976	16	6½
Remain—	77	04	1½	44	17	7	494	10	5½
Proof—	174	16	6¼	74	10	4	2471	07	0

	10	20	12	10	20	12	10	20	12 4
1ſt Due—	74	00	00	274	16	6	796	00	0
Paid——	46	12	10	197	19	4	279	11	7
Balance—	27	07	02	76	17	2	516	08	5
Proof—	74	00	00	274	16	6	796	00	0

Sometimes a ſum owing may be paid at ſeveral times; then the ſeveral payments muſt be added together, and their total deducted from the ſum firſt due as in this and the examples following.

Owing	450*l.*	
Paid at times	60 32 25 47 58 20 36	
Paid in all	278	Deduct
Remains due	172	
Proof	450	

	l.	*s.*	*d.*		*l.*	*s.*	*d.*
More due——	249	12	0	Received——	100	10	0
Received at ſeveral times	24	12	6	Paid to ſeveral perſons	6	16	0
	9	14	9		10	00	0
	20	00	0		5	12	6
	16	16	6		20	10	0
	22	10	2		7	09	6
	13	12	6		9	08	6
	7	16	4		7	12	6
Received in all	115	02	9	Paid in all	67	09	0
Reſts due—	134	09	3	Remains in the bag,	33	01	0
Proof——	249	12	0				

Avoirdupois Weight.

	10	20	4	28	10	4	28	10	16	16
	Tons.	*C.*	*qrs.*	*lb.*	*C.*	*qrs.*	*lb.*	*lb.*	*oz.*	*dr.*
From	44	12	1	10	246	2	12	146	02	10
Take	39	14	2	06	164	3	22	97	10	12
	4	17	3	04	81	2	18	48	07	14
Proof	44	12	1	10	246	2	12	146	02	1

Troy Weight.

	10	12	20	24	10	20	24
	lb.	*oz.*	*pwt.*	*gr.*	*oz.*	*pwt.*	*gr.*
From	462	04	10	11	1247	10	12
Take	196	09	06	16	976	16	17
n	265	07	03	19	270	13	19
Proof	462	04	10	11	1247	10	12

And ſo much for Subtraction; which method will ſerve for any denomination whatever, reſpect being had to the ſeveral tables of quantity, as before hinted in Addition.

MULTI-

MULTIPLICATION.

THE next rule in order is Multiplication, which, on account of its quick diſpatch in buſineſs, is perhaps the moſt uſeful rule in Arithmetic, as will appear from the following particulars.

1. Multiplication is a rule, that by two numbers given, teacheth to find out a third, which ſhall contain either of the two, as many times as the other containeth an unit.

2. Multiplication is alſo a compendious working of Addition.

3. It ſerves likewiſe to bring great denominations into ſmall, as pounds into ſhillings, pence, or farthings.

4. Having the length and breadth of a plain ſurface, we find its content in ſuperficial or ſquare meaſure.

5. By Multiplication, if we have the value of one thing, or the wages of one perſon, we can eaſily find the value of many ſuch things, or the wages of many ſuch perſons.

In Multiplication we are particularly to take notice of theſe three terms, *viz.*

The { Multiplicand,
Multiplier, *and*
Product.

1. The Multiplicand (generally the greater of the two numbers) is the number to be multiplied.

2. The Multiplier (generally the leſſer of the two numbers) is the number by which the former is to be multiplied.

3. The product is the reſult of the work, or anſwer. The Multiplier and the Multiplicand are collectively called Factors.

But before we proceed farther, it is neceſſary to have the following Table by heart, and that very perfectly.

The Multiplication Table.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

This table is ſo plain and eaſy, that there is no need of direction; for the product of any two figures will be found in that ſquare, which is on a line with the one, and under the other; thus 54 the product of 6 and 9, will be found on a line with 6, and under 9, or in a line with 9, and under 6; ſo 7 time 8 is 56, and 8 times 7 is 56, &c. And thus the table ought to be got by heart for the greater readineſs in multiplying.

Now for application.

Example 1. How many is 3 times 472? which being ſet down in the margin; I ſay, 3 time 2 is 6, which place under 3 the multiplier; then 3 times 7 is 21; ſet down 1 under 7, and carry 2 for the 2 tens, as in addition of one denomination, then 3 times 4 is 12, and 2 carried is 14; which ſet down, and the product is 1416.

$$\begin{array}{r} 472 \\ 3 \\ \hline 1416 \\ \hline \end{array}$$

Example 1. What is the amount of 3 times 654?

Anſwer; If you ſet the number 654, 3 times down on paper, one over another, and add them together, the total will be 1962.

But ſuch queſtions are done much more readily, by this rule of Multiplication. Set the numbers down thus:

654 Multiplicand
3 Multiplier.

Now to know how much 3 times 654 is, begin thus, ſaying 3 times 4 is 12, the figure 2 of the 12 ſet below the line, and bear the 10 of the 12 in mind, as 1; next, 3 times 5 is 15, and 1 that I bore in mind, makes 16; ſo I ſet the 6 below the line, and bear the 10 in mind as 1; next, I ſay 3 times 6 is 18, and 1 I bore in mind makes 19, which I ſet down, and the work will ſtand as in the margin.

654
3
1962

Example 2. How many is 3 times 472? Set the figures down as in the margin; then ſay, 3 times 2 is 6, which place under the 2 in the multiplicand; then 3 times 7 is 21; ſet down 1 under 7, and carry 2, for two tens, as in addition of one denomination; then 3 times 4 is 12, and 2 is 14; which ſet down, and the product is 1416, that is, 3 times 472 makes ſo much; as may be proved by Addition, by ſetting down 472 three times in additonal order, and caſting it up, which makes the aſſertion good in the ſecond definition, that this rule compendiouſly performs the office of Addition. Likewiſe the foregoing examples agree with the firſt definition; for, as 3 times 472 makes 1416, ſo doth 472 times 3 make the ſame, *viz.* 1416

472
3
1416

Example 3. Again, how many makes 742 multiplied by 4?

742 Multiplicand.
4 Multiplier.
2968 Product.

Here I ſay 4 times 2 is 8, and 4 times 4 is 16; 6 and carry 1; and 4 times 7 is 28, and 1 is 29, which I ſet down; ſo the whole product is 2968, as per Example.

More examples of one figure in the Multiplier:

Multiplicand.	6748	5293	7489
Multiplier.	4	5	6
Product.	26992	26465	44934

Compound Multiplication,

Is when the Multiplier conſiſts of more figures than one; and here you muſt begin with that figure which is in the place of units of the multiplier, and go thro' the whole Multiplicand, by multiplying each figure of it firſt by the ſaid unit figure, then by the next, to wit, by the figure in the place of tens of the Multiplier, then with the third, &c. to the laſt; always remembering to place the firſt figure of every product or line, (for you will ever have as many as you have significant figures in the Multiplier) I ſay, remembering to place the firſt figure of each line exactly and perpendicularly under the figure you multiply by; and then add the ſeveral lines or products together, which, ſo collected, give the total product required, as in the examples following, *viz.*

Example.

$$\begin{array}{r} 7426 \\ 23 \\ \hline 22278 \\ 14852 \\ \hline 170798 \\ \hline \end{array}$$

How many are 23 times 7426? Firſt, I begin with the unit figure 3 in the Multiplier, ſaying, 3 times 6 is 18; 8 (which I ſet directly under 3, by which I multiply) and carry 1; and 3 times 2 is 6, and 1 is 7; then 3 times 4 is 12; 2 and carry 1; then 3 times 7 is 21, and 1 is 22. And ſo I have done with the firſt figure of the Multiplier, *viz.* 3. Then I go to the next, that is 2, twice 6 is 12; 2 and carry 1; (which 2 is placed in a direct line under 2 the multiplying figure) then twice 2 is 4, and 1 is 5; then twice 4 is 8; and laſtly, twice 7 is 14, which I ſet down: Then I add the two products together, ſaying, 8 is 8, *&c.* and the total is the true product, or reſult of the Multiplication, *viz.* 170798.

To know how many hours there are in one year.

There are 365 days in a year, and 24 hours in a day, therefore I multiply 365 by 24, and to do that I ſet them thus:

```
 365
  24
────
1460
730
────
8760 hours in a year.
────
```

Then I proceed to multiply, ſaying 4 times 5 is 20, and ſet down the cypher under 4, and carry the two tens to the next place, ſaying 4 times 6 is 24, and 2 that I carry is 26; wherefore I ſet down the 6 under the figure 6, and carry the two tens to the next place, ſaying 4 times 3 is 12, and 2 that I carry is 14, which I ſet down.

Having multiplied the 365 by the figure 4, then I proceed to multiply it by the figure 2 of the 24, the Multiplier, after the ſame manner as I did the figure 4: Saying, 2 times 5 is 10, ſet a cypher under the 2, becauſe I multiply by 2, and bear 1 in mind. Next, 2 times 6 is 12, and 1 I bore in mind is 13, and the 3 of the 13 I ſet under the 4, and bear 1 in mind. Laſtly, I ſay 2 times 3 is 6, and 1 that I bore in mind makes 7, which 7 I ſet under the 1; and now having done multiplying, to finiſh the work, I add thoſe two numbers together, *viz.* the 1460 and 730, juſt as they ſtand; and they amount to 8760, as you may ſee in the example.

More examples of one figure in the Multiplier:

Multiplicand.	6748	5293	7489
Multiplier.	4	5	6
Product.	26992	26465	44934

Compound Multiplication,

Is when the Multiplier conſiſts of more figures than one; and here you muſt begin with that figure which is in the place of units of the multiplier, and go thro' the whole Multiplicand, by multiplying each figure of it firſt by the ſaid unit figure, then by the next, to wit, by the figure in the place of tens of the Multiplier, then with the third, &c. to the laſt; always remembering to place the firſt figure of every product or line, (for you will ever have as many as you have ſignificant figures in the Multiplier) I ſay, remembering to place the firſt figure of each line exactly and perpendicularly under the figure you multiply by; and then add the ſeveral lines or products together, which, ſo collected, give the total product required, as in the examples following, *viz.*

Example.

7426
23

22278
14852

170798

How many are 23 times 7426? Firſt, I begin with the unit figure 3 in the Multiplier, ſaying, 3 times 6 is 18; 8 (which I ſet directly under 3, by which I multiply) and carry 1; and 3 times 2 is 6, and 1 is 7; then 3 times 4 is 12; 2 and carry 1; then 3 times 7 is 21, and 1 is 22. And ſo I have done with the firſt figure of the Multiplier, *viz.* 3. Then I go to the next, that is 2, twice 6 is 12; 2 and carry 1; (which 2 is placed in a direct line under 2 the multiplying figure) then twice 2 is 4, and 1 is 5; then twice 4 is 8; and laſtly, twice 7 is 14, which I ſet down: Then I add the two products together, ſaying, 8 is 8, *&c.* and the total is the true product, or reſult of the Multiplication, *viz.* 170798.

To know how many hours there are in one year.

There are 365 days in a year, and 24 hours in a day, therefore I multiply 365 by 24, and to do that I ſet them thus:

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 365
  24
----
1460
730
----
8760 hours in a year.
----
```

Then I proceed to multiply, ſaying 4 times 5 is 20, and ſet down the cypher under 4, and carry the two tens to the next place, ſaying 4 times 6 is 24, and 2 that I carry is 26; wherefore I ſet down the 6 under the figure 6, and carry the two tens to the next place, ſaying 4 times 3 is 12, and 2 that I carry is 14, which I ſet down.

Having multiplied the 365 by the figure 4, then I proceed to multiply it by the figure 2 of the 24, the Multiplier, after the ſame manner as I did the figure 4: Saying, 2 times 5 is 10, ſet a cypher under the 2, becauſe I multiply by 2, and bear 1 in mind. Next, 2 times 6 is 12, and 1 I bore in mind is 13, and the 3 of the 13 I ſet under the 4, and bear 1 in mind. Laſtly, I ſay 2 times 3 is 6, and 1 that I bore in mind makes 7, which 7 I ſet under the 2; and now having done multiplying, to finiſh the work, I add thoſe two numbers together, *viz.* the 1460 and 730, juſt as they ſtand; and they amount to 8760, as you may ſee in the example.

If there be 8760 hours in one year, as in the laſt example, the next queſtion is, how many minutes are there in 8760 hours.

Hours in one year 8760
Minutes in one hour 60

525600

Note, That you are to obſerve to ſet the 6 of the 60 juſt under the laſt figure of the Multiplicand, next the right-hand, and the cypher 0 by itſelf; the ſame ought to be obſerved, if the Multiplier had been 600, or 6000, or 10, 100, or 1000, &c.

Now for the reſolving this queſtion, begin thus; the cypher 0 I ſet under the line. Next 6 times 0 is 0, which 0 I ſet under the line under the 6; next, 6 times 6 is 36, and the odd 6 of the 36 I ſet under the line, and bear three in mind for the 30, ſaying 6 times 7 is 42, with the 3 I bore in mind, make 45, the odd 5 I ſet between the lines, and bear four tens in mind.

Laſtly, 6 times 8 is 48, with the 4 I bore in mind makes 52; and the odd 2 I ſet under the line, and the 5 of the 52, (having no farther to carry it) I ſet it alſo under the line, and the whole ſum is 525600, as above.

If there are 525600 minutes in a year, how many minutes old may a young man be, that is 23 years of age? Set the queſtion down thus:

525600 Minutes in a year.
23 Years old.

Saying, 3 times 0 is 0, and ſet that under the 3; next 3 times 0 is 0, and ſet that under the 2; next, 3 times 6 is 18, I ſet the odd 8 under the line, and bear 1 in mind; next, 3 times 5 is 15, and the 1 I bore in mind makes 16, the odd 6 I ſet under the line, and bear 1 in mind, and ſay 3 times 2 is 6, and the 1 I bore in mind makes 7, which I ſet under the line. Next, I ſay 3 times 5 is 15, which 15 I ſet under the line, and the figure 3 of the multiplier is done with.

Next, multiply by the figure 2 of the multiplier, ſaying, 2 times 0 is 0, (which 0 I ſet juſt under the figure

2, as you may ſee below :) next 2 times 0 is 0, which I ſet under the figure of 8; next, 2 times 6 is 12, (the 2 of the 12 under the 6) and bear 1 in mind. Next, 2 times 5 is 10, and 1 I bore in mind, makes 11, the odd 1 I ſet under the 7, and bear 1 in mind. Next, 2 times 2 is 4, and the 1 I kept in mind, makes 5, which I ſet under the 5; 2 times 5 is 10, which ſet down as you ſee underneath.

Minutes in a year — 525600
Years of his age — 23

1576800
1051200

Minutes old — 12088800

Now I have done multiplying, and the two lines produced being added together, make 12088800; ſo that a young man of the age of 23 years may be ſaid to be twelve millions, 88 thouſand, 8 hundred minutes old.

☞ *Note,* 365 is ſet for the days of a year above, yet the *Julian* account makes it to conſiſt of ſix hours more.

Therefore I multiply 6 by 23, the young man's age in years, and it makes 138 hours; this multiplied by 60; the minutes in an hour, makes 8280 minutes to be added to

12088800 Minutes.
8280

Which makes in all 12097080 minutes in 23 years.

Again, What is the product of — 527527
Multiplied by — 285

2637635
4220216
1055054

150345195

More Examples.

$$\begin{array}{r} 527535 \\ 15728 \\ \hline 4220280 \\ 1055070 \\ 3692745 \\ 2637675 \\ 527535 \\ \hline 8297070480 \\ \hline \end{array} \qquad \begin{array}{r} 275827 \\ 19725 \\ \hline 1379135 \\ 551654 \\ 1930789 \\ 2482443 \\ 275827 \\ \hline 5440687575 \\ \hline \end{array}$$

When cyphers are intermixt with figures in the multiplier, then multiply by the figures as above: and when you come to a cypher in the multiplier, ſet down another cypher exactly and perpendicularly under it; then begin the multiplicand again with the next figure to the cypher in the multiplier, and go through it in the ſame line, placing the firſt figure of that product next to the cypher towards the left hand; but then care muſt be taken, that the next figure or cypher of the next line be ſet down one degree farther towards the left hand, and not immediately under the laſt figure ſet down next to the cypher: As in the following examples may be fully underſtood.

$$\begin{array}{r} 24393 \\ 402 \\ \hline 48786 \\ 975720 \\ \hline 9805986 \\ \hline \end{array} \qquad \begin{array}{r} 7864371 \\ 23604 \\ \hline 31457484 \\ 471862260 \\ 23593113 \\ 15728742 \\ \hline 185630613084 \\ \hline \end{array} \qquad \begin{array}{r} 327586 \\ 6030 \\ \hline 9827580 \\ 19655160 \\ \hline 1975343580 \\ \hline \end{array}$$

When you have a cypher or cyphers in the multiplier at the beginning towards the right hand; then ſet it or them backwards from the place of units towards the right hand; and when you have multiplied by the figure or figures, annex the cypher or cyphers:

As in theſe Examples.

$$\begin{array}{r} 4762 \\ 70 \\ \hline 333340 \\ \hline \end{array} \qquad \begin{array}{r} 47962 \\ 400 \\ \hline 19184800 \\ \hline \end{array} \qquad \begin{array}{r} 4632 \\ 2600 \\ \hline 2779200 \\ 9264 \\ \hline 12043200 \\ \hline \end{array}$$

If you have cyphers in the units place, &c. both in the multiplicand and multiplier, then neglect the cyphers in both, and multiply by the figures, and annex as many cyphers to the total product as is the ſum of the cyphers, both in the multiplicand and multiplier:

As in theſe Examples.

$$\begin{array}{r} 42600 \\ 220 \\ \hline 852 \\ 852 \\ \hline 9372000 \\ \hline \end{array} \qquad \begin{array}{r} 42300 \\ 12000 \\ \hline 648 \\ 324 \\ \hline 507600000 \\ \hline \end{array} \qquad \begin{array}{r} 376400 \\ 2400 \\ \hline 15056 \\ 7528 \\ \hline 903360000 \\ \hline \end{array}$$

When you are to multiply by 10, 100, 1000, or 10,000, it is only adding or annexing ſo many cyphers to the multiplicand as are in the multiplier, that is, either 1, 2, 3, or 4 cyphers, and the work is done. *Example,* Suppoſe I am to multiply 375 by the numbers above; if I multiply it by 10, then I join 0 to 375, and it makes 3750: If by 100, then I annex 00, and it makes 37500: If by a 1000 I put to it 000, and then it produces 375000: And laſtly, if by 10,000, I then add 0000, and it makes 3750000, &c. And thus may any number be multiplied, when the multiplier conſiſts of an unit with any number of cyphers.

Theſe directions may ſuffice for the manner of multiplying in general. The next thing is to ſhew the uſe of multiplication in real buſineſs, and how to apply it on proper occaſions: thus,

1. Suppoſe you want to know how many half-crowns there are in 246l. you know that 8 half-crowns make a pound; wherefore ſet them down thus:

246l.
Multiply by — 8 the half crowns in a pound.
————
Anſwer — — 1968 Half-crowns in all.

Again, In 1968 Half-crowns, how many pence?
Multiply by 30 the pence in a half crown.
————
Anſwer 59040 Pence in 1968 half-crowns.
————

And this ſerves to ſhew, that the great denominations are brought into ſmaller by this rule.

2. Suppoſe you wanted to know the contents of a large ſhuffle-board table 34 feet long, and four feet wide.

Multiply 34 the length
by 4 the breadth, and the
——
Anſwer will be 136 ſquare feet for the true contents of ſuch a table. ——

3. If I know the value of a yard of broad-cloth to be 12 ſhillings, what is the value of 220 yards of the ſaid cloth in ſhillings?

220
Multiply by 12
———
440
220
———
Anſwer 2640 Shillings, or 132*l.*
———

4. If the wages of one ſeaman be 23 ſhillings a month, what are the wages of 250 ſeamen for the ſame time.

250
Multiply by 23

750
500

Anſwer 5750 ſhillings, or 287*l.* 10*s.*

5. How many barley corns will reach from London to Bedford, if theſe places are 40 miles aſunder?

Fiſt ſet down the whole diſtance, *viz.*	40	miles.
Then multiply by 8, the furlongs in a mile,	8	
And the product is	320	furlongs
Multiply this by 40, the poles in a furlong,	40	
And the product is	12800	poles.
Multiply this by 11, the ½ yards in a pole,	11	
	12800	
	12800	
And the product is	140800	½ Yards.
Multiply this by 18, the inches in a half yard,	18	
	1126400	
	140800	
And the product is	2534400	Inches
Multiply this by 3, the barley-corns in an inch,	3	
And the product is	7603200	B. Corns

in 40 miles, the diſtance from London to Bedford.

6. Suppoſe it was aſked, how many barley-corns in length will reach from London to York, which is commonly accounted to be 150 miles.

Firſt ſet down the 150 miles, and multiply as in the laſt queſtion, and you will find the laſt product to be 28 millions, 512 thouſand barley corns.

Note, An Engliſh mile is 8 furlongs (as above.)

A Scottiſh and Iriſh mile, about one mile and an half Engliſh.

A Dutch and Poliſh mile, three Engliſh miles and an half.

A French, Italian, and Turkiſh league, near 2 Engliſh miles and 3 quarters.

A German mile is ſomewhat more than 4 Engliſh miles.

The Ruſſian mile, about 3 quarters of an Engliſh mile.

The Arabian mile, an Engliſh mile and a quarter.
The Hungarian mile is 5 miles Engliſh
The Moguls mile, a mile and a half Engliſh.

7. If the wages of one ſeaman be 14*s.* a month, what will the wages of 3349 ſeamen, for the ſame time come to?

```
 3349
   14
 ----
13396
3349
-----
46886 Shillings.
-----
```

The anſwer is 46886 ſhillings, which you may reduce into pounds by the ſecond example in reduction.

8. If an orchard contains 10 ſquares, and every ſquare have 10 trees, and every tree 10 branches, and every branch 10 apples, how many apples are there in the orchard? I anſwer, ten thouſand, *viz.*

The number of ſquares —— 10
The trees in one ſquare —— 10

The trees in all —— 100
The branches in a tree —— 10

The branches in all the trees 1000
The apples on a branch —— 10

The apples in the whole orchard 10000

And thus much for Common Multiplication. I ſhall next ſay ſomething of Multiplication of Money, and its various uſes, and ſo conclude this rule.

Multiplication of Money.

Multiplication of money (which moſt people ſhould learn above every thing elſe) hath great affinity with addition of money; the ſame method being obſerved in carrying from one denomination to the next, *viz.* from farthings to pence, from pence to ſhillings, and from ſhillings to pounds. And as in addition, (and other multiplications) you begin at the right-hand, and proceed towards the left; ſo here you begin at the loweſt denomination, which is alſo at the right-hand.

This method of accompting is the moſt eaſy and expeditious of any, for ſmaller quantities: and therefore extremely neceſſary in making bills of parcels, &c. And it is, beyond contradiction, as ſure and certain as any way whatſoever.

The general Rule

Is always to multiply the price by the quantity.

The firſt ſtep is, for quantities from 2 to 12; and this is done by the multiplier; as in the examples following.

Example 1. What muſt I give for ſix pieces of cloth, if one piece coſt 7*l.* 12*s.* 6d.

	l.	*s.*	*d.*
	7	12	6
Multiply the price by			6
And the product is the anſwer, *viz.*	£. 45	15	0

Here I ſay 6 times 6 is 36 pence, which is juſt 3*s.* I ſet down 0 in the place of pence, and carry 3*s.* to the place of ſhillings, (exactly the ſame as in addition of money) then 6 times 12 is 72, and 3 is 75*s.* or 3*l.* 15*s.* wherefore I ſet down 15 in the place of ſhillings, and carry 3 to the pounds; then 6 times 7 is 42 and 3 is 45*l.* So the whole amount of the 6 pieces of cloth, at 7*l.* 12*s.* 6*d.* per piece, is 45*l.* 15*s.* as in the work, which is very conciſe.

Example 2. How much is 9 times 13*s.* 4*d.* or what is the amount of 6 Marks?

s. *d.*
13 4
Multiply by 9

Anſwer £. 6 0 0

In this example I ſay, 9 times 4 is 36*d.* or 3*s.* I ſet down 0, and carry 3; then 9 times 3 is 27, and 3 makes 30; I ſet down 0, and carry 3, (as in multiplication of ſimple numbers;) then 9 times 1 is 9, and 3 is 12; which is the place of ten ſhillings, and being halved, make juſt 6*l.* and ſo much is the value of 9 Marks.

Example 3. What come 12 gallons of wine to, at 5*s.* 4*d.* per gallon?

Here I ſay 12 times 4 is 48, 0 and carry 4; then 12 times 5 is 60, and 4 is 64*s.* or 3*l.* 4*s.*

s. *d.*
5 4
12

£. 3 4 0

The next degree or ſtep of advance in this way of reckoning, is of quantities exceeding 12, even to 12 times 12, or 144; all which, as far as 144, are found in that excellent table, the table of multiplication; which is a ready help in all manner of reckoning, and particularly of this kind; and that you may proceed with eaſe, you muſt be very perfect in the ſaid table, that you may know immediately what component parts hit the quantity propoſed, or pretty near it; (for any quantity below 12 needs no recollection at all, as in two of the examples foregoing) and then work accordingly. If the quantity be 15 yards, I readily know that 3 and 5, or 5 and 3, are to be my multipliers. If the quantity be 21, then 3 and 7, or 7 and 3 will be the multipliers.

If 30, then 5 and 6, alſo 3 and 10, or 10 and 3. If 45, 48, 56, 66, 72, 96, &c. then 5 and 9, 6 and 8, 7 and 8, 6 and 11, 6 and 12, 8 and 12, &c. are to be multipliers, and exactly hit their ſeveral quantities of which they are component parts; and the examples of this kind have two multiplications for their ſolution.

When the quantity propoſed is a number irregular, or ſuch a number, that no two numbers in the table can be found to anſwer it, then we muſt multiply by two ſuch numbers as come pretty near it, as is ſaid above; and for the number wanting to make up the number or quantity propoſed, multiply the given price by the number that is wanting, which will make three products, by three multiplications; which laſt product muſt be added to the foregoing products reſulting from two multiplications, and the total will be the anſwer.

And firſt, I ſhall give examples of the ſecond ſtep, *viz.* of regular quantities that exceed 12, and are preciſely anſwered at two multiplications, ſuch as mentioned above, *viz.*

Example. What comes 15 yards of Holland to, at 3*s.* 5*d.* per yard?

Here 3 times 5 is 15*d.* or 1*s.* 3*d.* 3 and carry 1*s.*; then 3 times 3 is 9, and 1 is 10*s.* ſo the firſt product is 10*s.* 3*d.* which I multiply by 5, ſaying, 5 times 3 is 15*d.* or 1*s.* 3*d.* 3 and carry 1; then 5 times 10 is 50, and 1 is 51*s.* or 2*l.* 11*s.* So the whole amount of 15 yards, at 3*s.* 5*d.* per yard, is 2*l.* 11*s.* 3*d.* And demonſtrable thus, *viz.* If 10*s.* 3*d.* be the value of 3 times 3*s.* 5*d.* then 5 times the value of 10*s.* 3*d.* muſt of neceſſity be 15 times the value of 3*s.* 3*d.* becauſe 5 times 3 is 15: And its truth may be proved by addition and multiplication thus: Set down 3*s.* 5*d.* 3 times, in additional order, and put the three lines together, and the total of them multiply by 5, as before, and the anſwer will be the ſame. Or ſet down 17*s.* 1*d.*. (the product of 3*s.* 5*d.* multiplied by 5) 3 times alſo, and add them together, and the total will be exactly the ſame with the reſult by multiplication, as in the following ſpecimen of the work.

	s.	*d.*	
	3	5	
		3	and 5
	10	3	
		5	
2	11	3	

(1)	(2)	(3)
s. d.	s. d.	s. d.
3 5	3 5	17 1
3 5	5	17 1
3 5		17 1
	17 1	
10 3		2 11 3
5		
2 11 3		

Here the firſt of theſe two proofs is worked by addition and multiplication, and the ſecond by multiplication and addition. Alſo,

By this we ſee, that in all examples under this head, we are to find two numbers (for multipliers) in the table; which multiplied together, make the quantity propoſed; and then we are to multiply the price by one of the numbers (it matters not which) and then that product is to be multiplied by the other number, and the ſecond or laſt product will be the anſwer.

Example 2. What is the value of 21 gallons of Rum, at 7*s*. 9*d*. per Gallon?

s.	d.	
7	9	
	7	and 3
2 14	3	
	3	
8 02	9	

In this example I ſay, 7 times 9 is 63*d*. or 5*s*. 3*d*. I ſet down 3 and carry 5; then 7 times 7 is 49, and 5 is 54*s*. or 2*l*. 14*s*. So the firſt product is 2*l*. 14*s*. 3*d*, which I multiply by 3, and that produces the laſt product or anſwer, 8*l*. 2*s*. 9*d*.

More Examples without any verbal directions.

Example 3. What comes 30 ells of Muſlin to, at 3*s*. 7*d*. per ell?

		s.	*d.*	
		3	7	
			10	and 3
	1	15	10	
			3	
Anſw.	5	07	06	

Example 4. 45 pounds of raw Silk, at 15*s*. 6*d*. per pound.

		s.	*d.*	
		15	6	
			5	and 9
	3	17	6	
			9	
Anſw.	34	17	6	

Example 5. 56 buſhels of Wheat, at 4*s*. 9*d*. per buſhel.

		s.	*d.*	
		4	9	
			7	and 8
	1	13	3	
			8	
Anſw.	13	6	0	

Example 6. 72 Broad Pieces, at 23*s*. 6*d*. each.

s. *d*.
23 6
12 and 6

14 2 0
6

Anſw. 84 12 0

Example 7. 108 pounds of Indigo, at 7*s*. 8*d*. per pound.

s. *d*.
7 8
9 and 12

3 9 0
12

Anſw. 41 8 0

Example 8. 96 *C*. of Currants, at 2*l*. 13*s*. 6*d*. the *C*.

l. *s*. *d*.
2 13 6
8 and 12

21 8 0
12

Anſw. 256 16 0

The next ſtep of advance is of quantities irregular, or of numbers that are not to be anſwered preciſely at two multiplications: In this caſe there is no greater difficulty than in the examples foregoing; only here you will have an addition of one line more, occaſioned by bringing down the price of one to be added to the laſt product; or elſe a line more made by multiplying the price by what is wanting in the number by two multiplications, to make up the propoſed quantity compleat; as it may be of 2, 3, 4, 5, &c. this will be evident from the following examples.

Example 1. What is the product of 2*l.* 13*s.* 6*d.* multiplied by 39?

Here find that 6 multiplied by 6 makes 36; which is within 3 of the quantity propoſed; wherefore I multiply by 6, and that product again by the other 6; the laſt product is 96*l.* 6*s.* which is the product by 36; but we want to know the product by 39; wherefore I multiply the firſt ſum, *viz.* 2*l.* 13*s.* 6*d.* by 3 the defect or what is wanting to make up 36 to 39, ſaying 3 times 6 is 18*d.* &c. and find that 3 times 2*l.* 13*s.* 6*d.* is 8*l.* 0*s.* 6*d.* which added to 96*l.* 6*s.* gives the total, *viz.* 104*l.* 6*s.* 6*d.* the compleat product by 39; for 36 and 3 make 39. See the work above.

l.	*s.*	*d.*	
2	13	6	
		6	and 6
10	01	0	
		6	
96	06	0	
8	00	6	
104	06	6	Anſw.

Example 2. What comes 79 *C.* of Cheeſe to, at 28*s.* per *C?*

l.	*s.*	*d.*	
1	08	0	
		7	and 11
9	16	0	
		11	
107	16	0	
2	16	0	
110	12	0	Anſ.

In this example I ſay, 7 times 0 is 0; then 7 times 8 is 56, which is 2*l.* 16*s.* ſet down 16, and carry 2; then 7 times 1 is 7 and 2 is 9: So the firſt product is 9*l.* 16*s.* which multiplied by 11, produces 107*l.* 16*s.* or the value of 77; then for 2 wanting, I multiply the price by it, and that gives 2*l.* 16*s.* which added to 107*l.* 16*s.* makes the whole value 110*l.* 12*s.* as in the work.

Or, as there are no pence in the price, you may multiply 28*s.* by 79, without bringing it into pounds, as you work it, but omit it to the laſt, and then cut off or ſeparate the laſt figure or cypher of the product towards the right-hand, and halve thoſe towards the left, which will be pounds, and the figure cut off, ſhillings, as in this example.

s.
28
79
———
252
196
———
221 2
———
£.110 12
———

The half of 2 is 1, and the half of 2 is 1; and the half of 10, which 1 joined to the 2 ſevered from 221, makes 12; for the anſwer, 110*l.* 12*s* as before. This will be ſufficiently explained in Diviſion.

Example 3. 112 pounds of Sugar, at $5\frac{1}{2}$d per ℔. Set it down thus:

d.
$5\frac{1}{2}$ *per* pound
10 and 10
———
4 07
0 10
———
2 05 10
05 06 the product of $5\frac{1}{2}$d by 12 defective.
———
2 11 04 the anſwer.

Here after I have multiplied by 10 and 10 the parts of 100, there wants 12; wherefore I multiply $5\frac{1}{2}$d by 12, and it gives 5*s.* 6*d.* for 12 ℔. at $5\frac{1}{2}$d, which added to 2*l.* 5*s.* 10*d.* the value of 100, makes 2*l.* 11*s.* 4*d.* the true value of 112 ℔. at $5\frac{1}{2}$d per pound.

Example 4. 94 ſtone of Beef, at 22*d.* or 1*s.* 10*d.* per ſtone.

s. *d.*
1 10
10 and 9
——
18 4
9
——
8 05 0
7 4
——
8 12 4 Anſwer.

Here, what is wanting after the two multiplications is 4; wherefore I multiply 1*s.* 10*d.* (the price) by 4, which produces 7*s.* 4*d.* to be added, *&c.*

Example 5. 97 *C.* and a half of Raiſins, at 1*l.* 5*s.* 6*d.* per *C.*

£. *s.* *d.*
1 5 6
9 and 10
——
11 09 6
10
——
114 15 0
8 18 6
12 9 for the ½ *C.*
——
124 06 3 Anſwer.

After I have multiplied by 9 and 10, I multiply the price 1*l.* 5*s.* 6*d.* by 7, the quantity wanting, and it produces 8*l.* 18*s.* 6d. then for the half *C.* I take half of the price, which is 12*s.* 9*d.* and then collect the three lines, the total of which is 124*l.* 6*s.* 3*d.* for the anſwer.

Note, From the laſt example it is evident, that there is no need of being too ſolicitous to come ſo very near by two multiplications; for there 7 is wanting to make up the true quantity; nay, if the two multiplications come within 10 or 12, it is near enough; for 'tis as eaſy to multiply the price by 10 or 12, as by 2 or 3, and the addition is the ſame.

Example 6. What comes 110 *C.* ¾ of Hops to, at 4*l.* 10*s*, 6*d.* per *C.*

£.	s.	d.
4	10	6
		10 and 10
45	05	00
		10
452	10	00
45	05	00
2	05	03
1	02	07½
501	02	10½ Anſw.

After I have multiplied by 10 and 10, which makes 100; I multiply the price 4*l.* 10*s* 6*d.* by 10 that is wanting, which gives the ſame with the firſt product, *viz.* 45*l.* 5*s.* which ſtands under the product by 100; and for the ¾ of a *C.* I take ¾ of the price, *viz.* firſt the half, and the half of that half, that is 2*l.* 5*s.* 3*d.* and 1*l.* 2*s.* 7½*d*; which four lines added together, make 501*l.* 2*s.* 10½*d.* for the anſwer.

To prove Multiplication.

DIVIDE the Product by the Multiplicand or Multiplier, and the Quotient will be one of them.

This you cannot do before you have learnt the next rule, *viz.* DIVISION. For the preſent therefore take this method, *viz.* As you multiplied the multiplicand by the multiplier, ſo contrarywiſe multiply the multiplier by the multiplicand; and if the products are alike, the work is right; otherwiſe one of them is wrong, and muſt be gone over again till they do agree.

Example 1.

365	Days in a year.
24	Hours in a day.
1460	
730	
8760	Anſw.

Here (reverſely) I ſay, 5 times 4 is 20; 0 and carry 2; 6 times 4 is 24, and 2 is 26; 6 and carry 2; and 3 times 4 is 12, and 2 is 14; ſo that the whole product is 1460. Then 5 times 2 is 10; 0 and carry 1; 6 times 2 is 12, and 1 is 13; 3 and carry 1; and 3 times 2 is 6, and 1 is 7; which make 730. Which products added together make 8760, the hours in a year, as above, without taking in the odd 6 hours, which the year doth conſiſt of more than 365 days.

Example 2.

56 gallons of Spirits, at 3*s.* 2*d.* per gallon.

s. *d.*
3 2
7 and 8
———
1 02 2
8
———
8 17 4 Anſw.
———

I ſay here, twice 7 is 14; 2 and carry 1*s.* and 3 times 7 is 21, and 1 is 22*s.* or 1*l.* 2*s.* Again, twice 8 is 16*d.* 4 and carry 1s. and twice 8 is 16, and 1 is 17*s.* 17 and carry 0; and once 8 is 8*l.* Thus both theſe examples are the ſame in the end, as if you proceeded in the common and regular method of multiplication, and ſhews the truth of the operation, which ſhews the work to be right.

The next rule, in order, is DIVISION.

DIVISION.

THE uſe of this rule is to ſhew how many times one number or ſum is contained in another; as if it were aſked, how often is 8 contained in 48? the anſwer is 6 times; or how many times 12 is there in 60? anſwer 5 times.

As by Multiplication great denominations are brought into ſmall ones, as pounds into ſhillings, pence, or farthings; ſo by Diviſion, ſmall denominations are brought into greater, as farthings into pence, ſhillings, or pounds.

In this rule we are to take particular notice of the three following terms.

1 } The { Dividend, or number to be divided.
2 } The { Diviſor, or number by which we divide.
3 } The { Quotient, or anſwer to the work; which ſhews how often the Diviſor is contained in the Dividend.

4. The remainder; which is an uncertain branch of this rule, becauſe there is ſometimes a Remainder, and ſometimes not. ☞ And you muſt particularly note, that the Remainder is ever of the ſame denomination with the Dividend, and is always leſs than the Diviſor; for if it be more, or equal to the Diviſor, the work is wrong.

Diviſion is either ſingle or compound; ſingle when the diviſor conſiſts of a ſingle figure, and the dividend of two at moſt: Any queſtion of this kind is anſwered by the multiplication table; as if 72 were to be divided by 8, the anſwer will be 9 times. Here 72 is the Devidend, 8 the diviſor, and 9 the quotient or anſwer.

Compound Diviſion is when the dividend hath many, or more figures or cyphers than two, and the diviſor one or more figures or cyphers, &c.

Example.

How many times 7 are there in 365? or, how many weeks in a year?

```
7)365 (52 1/7
  35
  --
   15
   14
   --
   (1)
```

A general rule for working.

Note {
1. Seek
2. Multiply
3. Subtract
4. Bring down

Having ſet down the example with two crooked lines, or half parentheſis, one for the diviſor, and the other for the quotient, I begin according to the aforementioned general rule for working, by ſeeking or aſking how often I can take 7 the diviſor, out of 36, the two firſt figures of the dividend (for I cannot take 7 out of 3, the quotient being never to begin with a 0) and the anſwer is 5 times; wherefore I place 5 in the quotient, and multiply the diviſor 7 by it (as directed in the general rule,) ſaying 5 times 7 is 35, which I place under 36; and then thirdly, according to the ſaid rule, I ſubtract 35 from 36, and there remains 1; to which I bring down the next or laſt figure of the dividend, *viz.* 5, and then there is 15 for a new dividend to work upon; then I aſk or ſeek again, how oft 7 may be taken from 15? and the anſwer is two times; wherefore I put two in the quotient next to the 5; by which 2 I alſo multiply the diviſor 7, ſaying twice 7 is 14; which I ſet down under 15, and ſubtract, and there remains 1 which I place between parentheſis thus (1) as it ſtands in the work; where obſerve, that 365 is the dividend, 7 the diviſor, 52 the quotient, or anſwer, and 1 the remainder: The quotient declares that 7 is contained in 365, 52 times and 1 over, or remaining; which is placed after the quotient thus $\frac{1}{7}$, and ſignifies that there is one ſeventh of a week, or 1 day, more than juſt 52 weeks in a year, or 365 days; which is eaſily to be found, by collecting the days of each calendar month as they ſtand in the Almanack.

Note, That if there had been more figures or cyphers in the dividend, they muſt all have been brought down one by one at a time (and never but one at a time) and (after ſubtraction) ſet to the remainder; and if there remains 0, you muſt ſtill bring down but one figure or cypher at a time; and for every figure or 0 ſo brought down, there muſt be a figure or 0 placed in the quotient, according to the times you can take the diviſor out of the ſeveral dividends you make by bringing down a figure or cypher at a time out of the dividend, till all be brought down, and the work ended.

For a ſpecimen, let us divide 8060 pounds of tobacco equally amongſt 8 men.

8)8060

8)8060 (1007 Quotient.
8...
——
60
56
——
(4)

Here I ſay the eighths in 8 once, which I put in the quotient; then the eighths in 0, 0 times; which I likewiſe put in the quotient; then the eighths in 6, 0 times again; which is alſo placed in the quotient, and there remains 6; to which I bring down 0, the laſt of the dividend, and it makes 60: Laſtly, the eighths in 60, 7 times, 7 times 8 is 56, which take from 60, and there remains 4; ſo that the quotient ſhews that each perſon muſt have 1007 pounds of tobacco for his ſhare in the dividend 8060, and there remains 4 pounds over and above, which makes half a pound more to each man, becauſe 4 the remainder is half of 8 the diviſor; and ſo the work is done, the quotient gives to each man 1007 pounds and an half for his equal ſhare.

Note, That, in the operation, every time you bring down a figure or cypher, you are to make a point under it in the dividend, to ſignify that ſuch figure or cypher hath been brought down and done with, as may be obſerved in the foregoing example.

Though this way of working is plain, and eaſy to be underſtood, yet as it is ſomewhat tedious, I ſhall here ſhew a quick and expeditious method when the diviſor is a ſingle figure; this will appear in the following examples.

	I.	II.	III.
	4)78906	5)34567	6)29702
Quotient	19726 (2)	6913 (2)	4950 (2)
	4	5	6
Proof	78906	34567	29702

In the firſt of theſe examples I ſay, the 4's in 7 once and there remains 3, which conſidered as placed before 8, the next figure in the dividend, makes 38; then the 4's in 38, 9 times 4 is 36, from 38, and there remains 2; which makes 9, the next figure in the dividend, 29;

then the 4's in 29, 7 times; 7 times 4 is 28, from 29, and there reſts 1; which makes 0, the next of the dividend, 10, and the 4's in 10 twice; twice 4 is 8, from 10, and there remains 2; which makes 6, the laſt figure of the dividend 26; laſtly, the 4's in 26, 6 times, and 6 times 4 is 24, from 26, and there reſts 2 the remainder: And ſo for the other two examples. And for the proof of the work, (or of any other examples) multiply the quotient by the diviſor, and take in the remainder in the firſt place, or place of units; and if the product be the ſame with the dividend, the diviſor is right; for I ſay 4 times 6 is 24, and 2 the remainder make 26; 6 and carry 2, &c.

More Examples for a ſingle Figure.

	3)54321		7)279060		9)234567	
Quotient	18107	(0)	39865	(5)	26063	(0)
Proof	54321		279060		234567	

This is the ſhorteſt way of Diviſion that can be by a ſingle figure.

As it is neceſſary for expedition to multiply by 11 and 12, as by a ſingle figure, to have the product in one line; ſo it is likewiſe neceſſary to divide by them, as in theſe examples, *viz.*

	11)72646206		12)76677240
Quotient	6604200	(6)	6389770
	11		12
Proof	72646206		76677240

	11)47627000		12)42007400	
Quotient	4329927	(3)	3500616	(8)
	11		12	
Proof	47627000		42007400	

In the firſt of theſe examples I ſay, the 11's in 72, anſwer 6 times, &c. In the ſecond I ſay, the 12's in 76, anſwer 6 times, &c. In the third, the 11's in 47 4 times; 4 times 11 is 44, from 47 and there reſts 3, &c. In the fourth I ſay, the 12's in 42, three times 12 is 36, from 42, and there remains 6, &c.*

By being ready and expert in the examples above, you may eaſily divide by theſe numbers, *viz.* 110, 120, 1100, 1200, &c. for it is but cutting off, or ſeparating the cyphers from 11 and 12, (when theſe numbers happen to be the diviſors) and cutting off or ſeparating the like numbers of figures or cyphers from the right-hand of the dividend, and then divide the other figures or cyphers towards the left-hand, by 11 or 12, as it ſhall happen; as in the examples following, *viz.*

Divide 34567 by 110, and 890123 by 120, and 98765 by 1100, and 678901 by 1200.

	11,0)3456|7	12,0)89012|3
Quotient	$314\frac{2}{11}$ or $\frac{27}{110}$	$7417\frac{8}{12}$ or $\frac{83}{120}$
	11,00)987,65	12|00)6789|01
Quotient	$89\frac{8}{11}$ or $\frac{865}{1100}$	$565\frac{9}{12}$ or $\frac{901}{1200}$

When you divide by 10, 100, 1000 or 10000, &c. you have nothing more to do than to cut off, or ſeparate as many figures or cyphers of the dividend towards the right-hand, as you have cyphers in the diviſor; and thoſe figures towards the left make your quotient, and thoſe cut off towards the right-hand the remainder.

---

* This manner of multiplying and and dividing by numbers not exceeding 12, is now univerſally adopted.

Examples.

Divide 123456789 by 10, 100, 1000, 10000.

By 10 the quotient is 12345678, and the remainder 9.

By 100 the quotient is 1234567, and remainder 89.

By 1000 the quotient is 123456, and remainder 789.

By 10000 the quotient is 12345, and remainder 6789.

When the diviſor conſiſts of ſeveral figures, the work is attended with a little more difficulty; but if the following directions are carefully obſerved, the ſeeming difficulty may be eaſily overcome; as in the following example,

Suppoſe I am to divide 78901 pounds among 32 pariſhes; or ſuppoſe an aſſeſſment of ſo much money was laid on ſo many pariſhes, what muſt each pariſh pay by an equal proportion towards the raiſing ſuch a ſupply?

Diviſor 32)78901 (.... Quotient.

The example thus ſet down, I begin at the left-hand, ſeeking how often I can take 32 out of 78; or, more eaſily, How many times 3 is there in 7, and the anſwer is two times, which I place in the quotient thus, and then according to the general rule of working, I multiply the diviſor 32, by the 2 placed in the quotient, ſaying, twice 2 is 4, and twice 3 is 6; ſo there is 64 to be taken out of 78, as it appears in the margin.

```
32)78901(2
```

```
32)78901 (2
   64.
  -----
   14
  -----
```

Then I make a point under 9, the third figure of the dividend, and bring it down to the remainder 14, and then the work appears as in the margin.

```
32)78901 (2
   64
  -----
   149
  -----
```

Then ſeek again, aſking, how many times 32 is 149, which is not readily to be anſwered; but how many times 3, the firſt figure in the diviſor, is there in 14, the two firſt figures of the dividual 149, and the anſwer is 4 times; wherefore, after placing 4 in the quotient, I multiply (as directed in the general rule) the diviſor 32 by the ſaid 4, ſaying, 4 times 2 is 8, placing it under 9 in the dividual; then 4 times

```
32)78901(24
   64
  -----
   149
   128
  -----
   210
  -----
```

3 is 12, and ſet it down under 14; ſo there is 128 to be taken out of 149, and then the work appears as in the margin.

And after ſubtraction there remains 21; then I make a point under 0 in the dividend, and bring it down to the right of the remainder 21, and then there is 210 for a new dividual; then (as the general rule directs) I ſeek again, ſaying, How many times 32 the diviſor, is there in 210 the dividual? or eaſier, How many times 3 in 21? (for obſerve well, that whenever you have a place more in the dividual than in the diviſor, then always ſeek how oft you can take the firſt figure of the diviſor out of the two firſt of the dividual) and the anſwer is 7 times; but it will not bear 7 times, for 7 times 32 is 224, and you cannot take 224 out of 210, or rather, you cannot take 22 out of 21; wherefore try in your mind, before you ſet down the anſwer, or figure in the quotient, whether it will go the number of times as is moſt eaſily ſuggeſted; as here, the queſtion or demand is readily anſwered, 7 times, and ſo many times 3 may be taken in 21; but when you come to multiply the whole diviſor by the times you place in the quotient, you begin at the right hand and go towards the left, carrying the tens that ariſe to the next place; which increaſes the product ſo, that ſometimes the ſubtraction cannot be made, becauſe the under line is greater than the upper, or that which you ſhould ſubtract from; wherefore firſt try in your mind as abovesaid, and ſince it will not bear 7 times, try if it will go 6 times, ſaying, 6 times 2 is 12, 2 and carry 1, and 6 times 3 is 18, and 1 is 19, and 19 may be taken out of 21; therefore ſet down 6 in the quotient next to the 4, and multiply the diviſor 32 by it, and the work will ſtand thus:

Here

```
32)78901(2465
   64...
   -----
   149
   128
   -----
   210
   192
   -----
   181
   160
   -----
    21
   -----
```

Here the diviſor 32, multiplied by 6, gives 192 to be taken out of 210, and the remainder is 18; to which after a point made under it, I bring down the 1, the laſt figure in the dividend, and then there is 181 for a new dividual; then, acccording to the rule, I ſeek again, (for you are to note, That the aforeſaid general rule for working muſt be as often repeated as you bring down a figure or cypher from the dividend, to make a new dividual; and alſo, That for every figure or cypher brought down, there muſt likewiſe be a figure or cypher placed in the quotient;) how many times 32 the diviſor, may be taken out of 181 the dividual, or how many times 3 is in 18, and the ready anſwer is 6 times; but on trial, I find it will not go 6 times; wherefore I try a time leſs by one, *viz.* 5 times, and find it will bear it; and ſetting 5 in the quotient next the 6, I multiply the diviſor 32 by it, and it produces 160, which ſubtracted from 181, the laſt remainder is 21, and the quotient or anſwer is 2465, and ſhews, the 32 is contained in 78901, 2465 times, and 21 over, as per work.

Again; Suppoſe a Nobleman hath 30,000*l.* per annum, what is his daily income?

If you divide 30,000 by 365 (the days in a year) the quotient will be the anſwer. Set it down for working thus. 365) 30000 (

Firſt ſeek how many times 365 can be taken in 300; (an equal number of places with the diviſor) anſwer 0 times; wherefore I go a place further to the right-hand in the dividend, (for 0 muſt never begin the quotient) and make a point under it, *viz.* under the laſt 0 but one (as may be ſeen in the example) and there being a place more in this pointed out dividual than in the diviſor, I ſeek how oft the firſt figure of the diviſor, *viz.* 3, is contained in the two firſt figures or places of the dividend, *viz.* 30, and the anſwer is

10 times; but you are never to take above 9 times at once, in any of theſe examples of diviſion; wherefore try in your mind whether it will bear 9 times, before you ſet it down in the quotient (as was ſaid before) ſaying to yourſelf or in your mind, 9 times 5 is 45, 5 and go 4; and 9 times 6 is 54, and 4 is 58, 8 and go 5; and 9 times 3 is 27, and 5 is 32; now 32, cannot be taken out of 30, wherefore take a time leſs by a unit or one, *viz.* 8 times, and finding it will go 8 times, ſet 8 in the quotient, and then ſay, 8 times 5 is 40, 0 and carry 4; and 8 times 6 is 48, and 4 is 52, 2 and carry 5; and 8 times 3 is 24, and 5 is 29; and then there is 2920 to be taken from 30000, and there remains 80. Then to the remainder 80 I bring down 0, the laſt of the dividend, and then there is 800 for a new dividual; then you muſt try how oft you can take 365 out of the ſaid dividual 800, and the number of places being equal both in diviſor and dividual, to wit, 3, aſk, how oft 3 in 8, anſwer twice; ſo put 2 in the quotient, and ſay twice 5 is 10, 0 and carry 1; and twice 6 is 12, and 1 is 13, 3 and carry 1; and twice 3 is 6, and 1 is 7; ſo there is 730 to be deducted from 800, and the remainder is 70, as in the whole work may be ſeen.

```
365)30000 (8
    2920
    ————
      80
    ————
```

Thus by the work, the Nobleman hath 82 pounds *per diem*, and 70 pounds over; which if multiplied by 20 (the ſhillings in a pound) would produce 1400 ſhillings; which if divided *per* ſaid diviſor 365, there would come out 3*s.* a day more, and there will be a remainder of 305, which multiplied by 12, (the pence in a ſhilling) produces 3660, which divided ſtill by 365, gives 10*d.* a day more. So that 30,000*l.* a year is 82*l.* 3*s.* 10*d.* a day.

```
365)30000 (82
       ..
    2920
    ————
     800
     730
    ————
      70
```

Divide 46242 gallons of Canary, by 252 (the gallons in a tun.) Thus ſet down.

252)46242 (183
252 . .
———
2104
2016
———
882
756
———
126
———

In this example, after enquiry, I find that it will not go twice, therefore I ſet down 1 in the quotient, and place 252 and 462 of the dividend, and after ſubtraction, the remainder is 210, to which I bring down 4 from the dividend, and the dividual is 2104; and then ſeeking again, find it will bear 8 times, which placed in the quotient, and the diviſor 252 multiplied by it, the product is 2016 to be ſubtracted from 2104, which being done, the remainder is 88; to which 2 (the laſt figure of the dividend) being brought down, there is 882 for the laſt dividual; and then ſeeking again, I find it will go 3 times, and the product of the diviſor multiplied by 3, is 756, which ſubtracted from 882, there remains 126 for the laſt, or true remainder. So that by this diviſion I find there are 183 tuns in 46242 gallons, and 126 gallons remaining, or over and above; which being half of 252 the diviſor, the remainder is therefore half a tun more.

When you have a cypher or cyphers in the diviſor in the firſt, ſecond, or third place, *&c.* ſeparate ſuch cypher or cyphers, with a daſh of the pen, from the reſt of the diviſor: and alſo cut off as many figures or cyphers from the right of the dividend, as you cut off cyphers from the diviſor, and divide the remaining figures towards the left-hand, by the remaining ſignificant figures of the diviſor.

Divide 42952 *ſquare poles of land by* 160 *the ſquare poles in an acre of land.*

Here the cypher is cut off from the diviſor, and 2 from the dividend; then I aſk, How oft 16 in 42? Anſwer, twice, then the 16's in 109, Anſwer ſix times; then the 16's in 135, Anſwer 8 times. So there are 268 acres, and 7 remains; that is, 268 acres $\frac{7}{16}$ or $\frac{70}{160}$ or almoſt half an acre.

```
16 | 0)4295 | 2 (268
      32
     ----
     109
      96
     ----
     135
     128
     ----
       7
     ----
```

Divide 6274620 *by* 2700

```
27 | 00)62746 | 20 (2323 2520/2700
       54...
       -----
        87
        81
       ----
        64
        54
       ----
       106
        81
       ----
        25
       ----
```

In this example two cyphers are ſeparated from the diviſor, and alſo two places from the dividend, and then 62746 is divided only by 27. See the Work.

When the diviſor is 3, 4, 5, 6, or more figures, there is a ſure and eaſy way of performing the work truly, by making a table of the diviſor; which may be done by addition, or multiplying the diviſor by 2, 3, 4, &c.

Suppoſe you are to divide 987654321 *by* 123456

123456) 987654321 (8000
987648...

6321

Here having noted the number of figures in the diviſor, which here is ſix, I make a point under the ſeventh figure, or place of the dividend, &c.

1	123456
2	246912
3	370368
4	493824
5	617280
6	740736
7	864192
8	987648
9	1111104

This table is made by doubling the firſt line, which is 246912, which added to the firſt or uppermoſt line gives the third line 370368, which alſo added to the ſaid firſt line makes 493824 for the fourth line or product; and ſo of the reſt, ſtill remembering to add the ſubſequent line, or product to the firſt or uppermoſt line, till you come to the laſt line of 9 times, which is 1111104. The truth of which may be proved by multiplying the firſt or uppermoſt line by 2, 3, 4, 5, &c. And if you commit an error by addition, it may be found out or corrected by Multiplication.

When you have pointed out your number of places in the dividend, caſt your eye on the table, and at the firſt view you may know how many times you can take; as in this example, 7 times is too little, and 9 times too much; wherefore I ſet down 8 in the quotient, and then multiply and ſubtract, and the remainder is 6; to which I bring down 3, and put 0 in the quotient; then to the 63 I bring down 2, and place another 0 in the quotient; then to 632 I bring down 1, the laſt figure of the dividend; but ſtill it will not bear any time or times, wherefore I put another 0 in the quotient; and ſo the work is done, and the quotient is 8000, and the remainder 6321; as in the work.

Thus having plainly, fully, and pertinently ſhewn, by verbal directions, the method of working diviſion, I think it unneceſſary to give any more examples in that manner; but ſhall leave ſome few examples for practice ſake, whoſe quotients and remainders are expreſſed, but the operation omitted, to ſave room, and for trial of the ingenuity of practitioners.

7400690042 divided by 987, the quotient is 7498166, and remainder 200.

479679002742 divided by 4689, the quotient is 102298784, and remainder 4566.

7969767002 divided by 976294, the quotient is 8163, and remainder 279080.

456789012345 divided by 9876543, the quotient is 46249, and remainder 8775138.

76469747 divided by 4500, the quotient is 16993, and remainder 1249. And,

809240000 divided by 345000, the quotient is 23456, and remains 0.

The Proof of Multiplication and Diviſion.

THESE two rules reciprocally prove each other; for in proving multiplication, if you divide the product by the multiplier, the quotient will be like the multiplicand; or if by the multiplicand, the quotient will be the ſame with the multiplier.

Example.

```
        345                 Or thus,
         24              345)8280 (24
       ----                  690
       1380                  ----
       690                   1380
       ----                  1380
    24)8280 (345             ----
       72..                     0
       ----                  ----
       108
        96
       ----
        120
        120
       ----
          0
       ----
```

To prove Diviſion.

Diviſion may be proved by Diviſion thus:

If you divide the dividend by the quotient, the quotient will be your former diviſor.

Example. Divide 8280 by 345

Here the working again is needleſs, it being above; and ſhews the truth of the aſſertion, that diviſion may be proved by diviſion as aforeſaid.

But the moſt uſual way of proving diviſion is by multiplication, in this manner, *viz.* Multiply the quotient by the diviſor, and the product will be equal to the dividend; as in the foregoing example.

```
 345 Quotient.
  24 Diviſor.
 ----
1380
690
 ----
8280
 ----
```

Note, That where there is any remainder, ſuch remainder muſt be taken in or added to the product.

As in multiplication I gave ſome examples of its utility in money, ſo likewiſe I ſhall give a few examples in Diviſion of money; whereby you may ſee how expeditiouſly ſome things may be done, without having recourſe to reduction, the rule of three, *&c.*

Example 1. *Divide* 26l. 12s. 6d. *equally among* 5 *men.*

For diſpoſition of working ſet it down as follows:

```
       l.  s. d.
   5)  26 12  6
   ------------
        5 06  6
              5
   ------------
Proof  26 12  6
   ------------
```

In working of this, I ſay, the 5's in 26, 5 times; 5 times 5 is 25, from 26 and there remains 1, or 1*l.* or 20*s.* which, with the 12s. in the place of ſhillings makes 32*s.* then the 5's in 32, 6 times; 6 times 5 is 30, from 32 and there remains 2*s.* or 24*d.* which with the 6*d.* in the place of pence, makes

30; then the 5's in 30, 6 times; and ſo the work is done; and the anſwer is, that each man muſt have 5*l.* 6*s.* 6*d.* for his equal ſhare in the ſaid diviſion of 26*l.* 12*s.* 6*d.* amongſt 5 perſons; and the truth of it is proved by multiplication of money, ſufficiently ſhewn in the rule of multiplication; as here 5 times 6 is 30, 6 and carry 2; and 5 times 6 is 30 and 2 is 32, 12 and carry 1; and 5 times 5 is 25, and 1 is 26, &c.

Example 2. *Divide the charges of a country-feaſt, amounting to* 246l. 13s. 4d. *equally amongſt* 12 *Stewards, to know what each Steward muſt pay.*

	l.	*s.*	*d.*
12)	246	13	4
Anſwer	20	11	$1\frac{4}{12}$

Here, I ſay, the 12's in 24, twice, and the 12's in 6, 0 times and there remains 6*l.* or 120*s.* and 13*s.* makes 133; then the 12's in 13 once, and the 12's in 13 once, and there remains 1*s.* or 12*d.* then 12 and 4 is 16; the 12's in 16 once, and 4 remains; ſo that each Steward muſt pay 20*l.* 11*s.* 4*d.*$\frac{4}{12}$ or four twelfths of a penny, ſomething more than a farthing; and this may be proved as that above.

When any quantity is ſuch a number, that any two digits of the multiplication table, multiplied together, make the ſaid quantity or number, then the quotient may be very expeditiouſly found at two diviſions, and ſooner than at one. *Example:* Divide 7872 by 32. In this example, the digits, component parts, or numbers, which multiplied together, make the diviſor 32 are 4 and 8, or 8 and 4; for it matters not which of the numbers you divide by firſt; for both diviſions together give a true anſwer and the ſame quotient; as may be ſeen by the different methods in the following work.

4)7872	Or thus, 8)7872
8) 1968	4) 984
246 quotient	246 quotient

Here though the operations are different, yet the quotients are the ſame. Again, divide 44184 by 56.

Example 3.

7)44184

8) 6312

789 quotient.

Here the diviſors are 7 and 8, or 8 and 7; for either or both, will give the ſame quotient.

And thus may above forty examples be wrought by numbers out of the multiplication table, with great diſpatch and expedition, as by 15, 18, 25, 35, 64, 72, 96, &c.

When it happens that there is any remainder in the firſt diviſion, or the laſt, or in both; to know the true remainder, as if you divided by the common way, take this method, *viz.* multiply the firſt diviſor by the laſt remainder, and take in or add the firſt remainder, if there be any, and the product will be the true or ſame remainder as if you divided by the long way.

Example.

Divide 4567 by 15.

Here I multiply 3, the firſt diviſor, by 2, the laſt remainder, and take in 1, the firſt remainder, and it makes 7 for the true remainder, as may be proved at leiſure, by the other way.

3)4567

5)1552 1

304 2

7

The ſame method may be taken with reſpect to component parts in diviſion of money, as in diviſion of ſimple numbers.

Example. Divide 463*l.* 12*s.* 06*d.* into 18 equal parts.

	l.	*s.*	*d.*
3)	463	12	06
6)	154	10	10
Anſw.	25	15	$10\frac{4}{6}$

By this method of diviſion of money (if the quantity be as aforeſaid, made by even component parts) you may, by having the price of ſeveral things, know the price or value of one thing, at the ſaid rate, as well as by the rule of three: So doth multiplication of money anſwer queſtions in the rule of three, when the firſt number is a unit or one.

Example by Diviſion.

If 84 ℔. *of Coffee coſt* 31l. 10s. 0d. *what is that a* ℔?

7)	31	10	0
12)	41	0	0
Anſw.	0	07	6 a pound.

As in multiplication of money, to have an anſwer, you multiply the price by the quantity; ſo in diviſion of money, you divide the price by the quantity to have your anſwer.

And this may ſuffice at preſent for multiplication and diviſion, the various and excellent uſes of which will be better underſtood in the following rules of arithmetic, particularly in the next rule, called REDUCTION.

REDUCTION.

REDUCTION is performed by the foregoing rules of multiplication and diviſion.

For any greater name or denomination is brought into a ſmaller by multiplication, by multiplying by ſo many of the ſmaller as makes one of the greater.

Thus if you multiply pounds in money by 20, the product is ſhillings: or ſhillings by 12, the product is pence: or pence by 4, the product is farthings.

On the contrary, all ſmaller denominations are brought into greater by diviſion, by dividing the ſmaller denomination by as many of the ſmaller as makes one of the greater.

Thus, if you divide any number of farthings by 4, the quotient ſhews the pence; pence divided by 12, give ſhillings in the quotient; and ſhillings divided by 20, give pounds in money in the quotient.

In 520l. *how many ſhillings, pence, and farthings?*

```
                520 l.
                 20
              ------
    Shillings 10400
                 12
              ------
              20800
             10400
              ------
    Pence    124800
                  4
              ------
    Farthings 499200
```

How many ſhillings, pence, and farthings are there in 224l. 15s. 6d.

```
     l.  s. d.
    224 15  6
     20
   ------
   4495 Shillings
     12
   ------
   8996
  4495
   ------
  53946 Pence
      4
  ------
 215784 Farthings
```

In 499200 *farthings, how many pence, ſhillings, and pounds?*

4)499200
12)124800*d.*
20)10400*s.*
520*l.*

How many Pounds are there in 6 *hundred weight and* 3 *quarters?—Note,* An hundred weight is 112 ℔.

C. *qrs.*
6 3
4
27
28 a quarter of a *C.* is 28 ℔, or a tod.
216
54
756 pounds.

Caſe 1.] When a number of one denomination is given to be reduced into a leſſer denomination.

Rule.] Multiply the given number by ſo many units of the inferior denomination into which you would have the number reduced, as are contained in an unit of the denomination which is given, and the product is the anſwer.

Example 1. *In* 564 *pounds how many farthings?*

564 pounds.
960 farthings in a pound
33840
5076
541440 farthings for anſwer.

Example 2. *In* 87 *hundred weight, how many pounds?*

87 hundred.
112 pounds in one hundred.

174
87
87

9744 Pounds for anſwer.

Example 3. *In* 527 *Ells* Flemiſh, *how many quarters of a yard, each ell being three quarters of a yard.*

527 ells
3 quarters of a yard in an ell *Flemiſh.*

1581 quarters of a yard for anſwer.

Example 4. *In* 328 *bales of Dowlas, how many pieces?*

328 bales.
3 pieces in a bale.

984 pieces for anſwer.

Example 5. *In* 484 *groſs of tape, each groſs* 12 *dozen, each dozen* 2 *pieces, and each piece* 36 *yards, how many yards?*

484 groſs.
12 dozen in a groſs.

5808 dozens in 484 groſs. } Multiply
72 yards in a dozen. }

11616
40656

418176 yards for anſwer.

Caſe 2.] When it is required to reduce numbers of divers denominations into the loweſt denomination.

Rule.] Work as in the laſt Caſe; but if you have any number of the next inferior denomination to that you are reducing, add ſuch number to the product.

Example 1. *In* 364l. 5s. 5d. *how many pence?*

l. *s.* *d.*
364 5 5 Multiply and add the 5*s.*
20 the ſhillings in a pound.

7285 Shillings in 364*l.* 5*s.* } Multiply and add the 5*d.*
12 Pence in a ſhilling }

87425 Pence in 364*l.* 5*s.* 5*d.* for anſwer.

In the laſt example in reducing the pounds, ſay 0 times 4 in the pounds is 0, but 5 (in the ſhillings) is 5 ſhillings; then ſay, 2 times 4 is 8, &c. And, when you come to the ſhillings, 2 times 5*s.* is 10, and 5 in the pence place is 15*d.* put down 5 and carry 1, &c. *Note,* That if you add any thing in the ten's place, either in the ſhillings, pence, &c. you muſt add them when you multiply by the figure in the ten's place of the multiplier.

Example 2. *In* 48l. 17s. 11d. 2q. *how many farthings?*

l. *s.* *d.* *q.*
48 17 11 2 Multiply and add the 17*s.*
20 the ſhillings in a pound.

977 Shillings in 48*l.* 17*s.* } Multiply, adding the 11*d.*
12 Pence in a ſhilling. }

11735 Pence in 48*l.* 17*s.* 11*d.* } Multiply & add the 2*q.*
4 Farthings in a penny. }

49942 Farthings in 48*l.* 17*s.* 11*d.* 2*q.* for Anſ.

Example 3. *In* 47 C. 2 qrs. 24lb. *how many pounds?*

C. qr. ℔.
46 2 24 } Multiply, and add
4 quarters in 112 ℔. } the 2 qrs.

190 quarters in 47 C. 2qrs. } Multiply, and
28 pounds in 1 Q. of C. } add the 24 ℔.

1524
382

5344 pounds is 47 C. 2qrs. 24 ℔. for anſwer.

This queſtion is more briefly reſolved, as in the margin, by firſt putting down your 47C. 4 times, and the 2qrs. 24 ℔. which is 80 ℔. in tens and units place; ſo the ſum is the anſwer.

47C. 2qrs. 24 ℔.
47
470
478

5344 ℔. for Anſw.

Reduction Ascending.

Is, when numbers are reduced from a leſſer into a greater denomination.

Caſe 1.] When the number given is to be reduced to the next ſuperior denomination.

Rule.] Divide the ſaid given number by ſuch a number of units of the denomination given, as makes an unit of the next ſuperior denomination, and the quotient is the anſwer.

Example 1. *In* 984 *pieces of Dowlas, how many bales, each* 3 *pieces?* See the operation.

3)984

323 bales for anſwer.

Example 2. *In* 9744 *pounds, how many hundred weight?*

112)9744 (87 hundred weight for anſwer.
896
784
784
0

Caſe 2.] When the number is to be reduced to a denomination higher than the next ſuperior denomination.

Rule.] Divide the given number, as before, by ſuch a number of the units of the denomination given, as makes an unit of the next higher denomination, and note the remainder. Then divide that quotient by ſo many units of that name or denomination which it is of, as makes an unit of the next higher denomination to the ſaid quotient, *&c.* noting the remainders, as in the example following.

Example 1. *In* 87425 *pence, how many ſhillings, and pounds?*

d.
12)87425
20)72585 5
Anſw. £.364 5 5

Example 2. *In* 5344 ℔. *how many quarters and hundreds?*

lb. *Q.* C.
28)5344 4)190 (47
28.. 16
254 30
Rem. *lb.* 24 2 Quarters remain.
Anſwer 47*C.* 2*Q.* 24*lb.*

Example 3. *In* 418176 *yards, how many groſs of Tape?*

Divide the given number by 72, and that quotient by 12, for anſwer; becauſe 72 yards is 1 dozen, and 12 dozen 1 groſs.

Yards. *Dozens.*
72)418176 12)5808 (484 groſs for anſwer.
360...
581
576
0 Rem.

Theſe queſtions are the converſe of thoſe in reduction deſcending, and may ſerve for the proof of them; and likewiſe to ſhew the learner the nature and effects of the rules.

Reduction Aſcending and Deſcending

Are thoſe queſtions that are performed by multiplication and diviſion; ſuch as theſe that follow, and the like.

Example 1. *In* 874 *Ells* Flemiſh *how many ells* Engliſh?

Multiply the given number by 3, and divide the product by 5, and the quotient is the anſwer.

874 Ells Flemiſh.
3 Qrs. of a yard in 1 ell. Multiply
5)2622 524$\frac{2}{5}$ Ells for anſwer.
25..
12 -
22 Anſw. 524$\frac{4}{10}$ or $\frac{2}{5}$
2 rem. which placed over the diviſor is $\frac{2}{5}$

874
6

Or multiply by 6 and divide by 10, which is ſhorter.

Note, That the remainder is always of the ſame denomination with the dividend.

Example 2. *In* 46C. *of Cotton Wool, how many pounds, and what is the price at* 15d. *a pound?* Anſw. 322*l.*

46*C.*	*d.*	*s.*	*l.*
46	12)77280	|0)644|0	322
46	72...	6..	
46			
	52	4	
5152 Pounds.			
15 Pence for 1 pound	48	4	
25760	Remains 0	0 Remains	
5152			

77280 Pence for anſwer, which reduce into pounds as before taught, and per margin.

More promiſcuous Examples *of both kinds of Reduction, one proving the other.*

In 276l. 12s. *how many Pence?*

20
5532
12
Anſw. 66384*d*.

12)
In 66384d. *how many pounds?*
2|0)553|2
Anſw. £.276 12

In 47964 *grains, how many pounds* Troy?

24)47964
24...
239
216
236
216
204
192
Grains 12

2|0(199|8
12) 99 18 *pw.*
8 *lb.* 3 *oz.*

lb. oz. pw. gr.
In 8 3 18 12 *how many grs.*
12
99
20
1998
24
7994
3997
Anſw. 47964 and proof.

Anſw. 47964 grains.

In 34C. $\frac{3}{4}$ *of Cotton Wool, how many pounds?*

C.	C.
34	112)3892 (34$\frac{3}{4}$ Proof
34	336
34	——
34|84	532
——	448
3892	——
——	84 ℔. or $\frac{3}{4}$ of a C.

In 456C. 3qrs. 27℔. *of Copper, how many pounds? And what it comes to at* 21d. *per* ℔.

C.	*Or thus,* C.
456	456
456	112
456	——
456	5472
111	456
——	111
51183 Pounds at 21*d*. per ℔.	——
——	51183 pounds.
51183	——
102366	
——	

1074843 Pence; which bring into pounds by diviſion, ——— or reduction aſcending, as before ſhewn, and it will amount to 4478*l*. 10*s*. 3*d*.

Bring 4796 *Ells* Flemiſh *into Ells* Engliſh

Multiply by 3, and divide by 5; becauſe 3 quarters make an ell Flemiſh, and 5 an ell Engliſh.

4796
3
———
5)14388
———
2877$\frac{3}{5}$

Reduce 546 *Ells* Engliſh *into Yards.*

Multiply by 5, and divide by 4, thus:

456 Engliſh ells.
5 qrs. 1 E. ell.
4)2280 quarters.
Yards 570 Anſwer

In 570 *yards how many ells* Engliſh?
570
4 Qrs. in a yard.
5)2280
Engliſh ells. 456 Anſ. and proof.

Bring 130 *tuns of Wine into gallons.*

4
520
63 Gallons 1 Hhd.
1560
3120
Anſwer 32760 Gallons.

Or thus,
252 Gall. 1 Tun.
130 Tuns
7560
252
32766

And ſo on the contrary by Diviſion.

	Laſts,	*Qrs.*	*Buſhels*	*Pecks.*
Reduce	42	3	5	2 *into Pecks.*

10 qrs. 1 laſt.
423 qrs.
8 buſhels 1 qr.
3389
4 pecks 1 buſh.
13558 pecks, in 42 laſts, 3 quarters, 5 buſhels, and 2 pecks.

Here I multiply by 10 and take in 3 *qrs.* and then by 8, and take in 5 buſhels; and laſtly by 4, and take in 2 pecks.

In 13558 *Pecks, how many Laſts,* &c.

4)13558

8)3389-2 pecks taken in

1|0)42|3-5 buſhels taken in

Laſts 42—3 quarters taken in

Anſwer, 42 laſts, 3 quarters, 5 buſhels, 2 pecks.

Thus, by the two foregoing examples it is ſeen, that reduction aſcending and deſcending mutually prove each other, as was ſaid before; and is no more than mutiplication and diviſion proving one another.

By Reduction alſo foreign coins or exchanges may be reduced into ſterling money; and, on the contrary, ſterling money into foreign.

Example. *Reduce* 246 *Venetian Ducats de Banco into ſterling money, the exchange at* 52d. *ſterling per ducat, thus:*

246

52

492

1230

12)12792

2|0)106|6

53*l.* 6*s.* To be paid in London for the 246 ducats drawn in Venice.

Reduce 53l. 6s. *ſterling into ducats at* 52d. *ſterling per ducat.*

l. *s.*
53 6
20
1066
12
52)12792(246 Ducats to be paid in Venice for
104 the 53*l.* 6*s* drawn in London.
23, &c.

To reduce Flemiſh money into Sterling money, divide the pence Flemiſh by the par of exchange, *viz.* 33*s.* 4*d.* and the quotient will be the ſterling money; and what remains multiply by 20, &c.

Example. *In* 242l. 13s. 4d. Flemiſh, *how many pounds ſterling*, &c.

242*l.* 13*s.* 4*d.*
20
33*s.* 4*d.* Flemiſh
12
4853
12
400
4 | 00)582 | 40
l. 155 Sterl.
Remains 240
20
4 | 00)48 | 00

Anſwer 145*l.* 12 Shillings Sterling.

By the work it appears, that 145*l.* 12*s.* ſterling, anſwers, or is equivalent to 242*l.* 13*s.* 4*d.* Flemiſh, at 33*s.* 4*d.* Flemiſh per pound ſterling.

Thus Flemiſh money may be reduced to ſterling money, though the *par* of exchange be at any other rate of ſhillings or pence Flemiſh: But when at the rate as above, *viz.* 33*s.* 4*d.* (the common *par*) then the anſwer is ſooner found by multiplying by 3, and dividing by 5; for 400*d.* Flemiſh is the ſame to 240*d.* ſterling, (each being a pound) as 3 is to 5; for if you divide 240 by 3, it quotes 80; ſo 400 divided by 5 quotes the ſame.

The foregoing *Example* done by the laſt propoſed method.

£. 344 15 4 *Flemiſh.*
3

5)7220 00 0

£. 144 08 0

Note, French money is reduced to pounds ſterling, by bringing it firſt to pence ſterling and then dividing by 12 and by 20.

In 426 *French crowns, each* 54d.$\frac{1}{4}$ *Sterling, how many pounds,* &c. *Sterling?*

F. C.
426
54

1704
2130
106$\frac{2}{4}$ or $\frac{1}{2}$*d.*

12)2,110 10*d.*

And this 2 | 0)192 | 5
1925 divided by
20 makes Anſ. *l.* 96 5 10$\frac{1}{2}$ *St.*

In this example, the number of crowns is multiplied by 54*d.* and for that I take the 4th part of 426, which is 106$\frac{2}{4}$ of a penny, or a halfpenny; which added to the other pence, gives for total 23110*d.* which divided by 12 quotes 1925, and 10*d.* remains; ſo the anſwer is 96*l.* 5*s.* 10*d.*$\frac{1}{2}$ ſterling: As in the work.

Again, Bring 1600 *pieces of eight* Mexico, *at* 54d. $\frac{1}{4}$ *ſterling, into pounds,* &c. *ſterling.*

```
      1600
        54
    ------
      6400
     8000
       400
    ------
  12)86800
  --------
2|0)723|4 6
  --------
£. 361 13 4
```

Here the 1600 pieces of eight are multiplied by 54, to bring them into pence; and for the $\frac{1}{4}$ I take the $\frac{1}{4}$ of 1600, &c. as in the work. And the anſwer is, £. 361 13 4.

This method is of uſe in reducing the exchanges of Cadiz, Leghorn, and Genoa. Or when the exchange is at ſo many pence, and eighths of a penny (as often the exchanges run) then multiply the given number to reduce it into pence, by the pence contained in a piece of eight; and alſo multiply the ſaid given number apart, by the numerator or upper figure of the fraction, and divide by the denominator or under figure of the fraction, and the quotient will be pence; which add to the other pence produced by multiplying the given numbers by the pence contained in one of the pieces for exchange; then divide the total pence by 12, &c.

Example. *Bring 296 dollars at* 52d. $\frac{5}{8}$ *ſterling, into pounds,* &c. *ſterling.*

```
   296 Dollars.
    52
   ———                Dollars.
   592                   296
  1480                     5
 ——————                ——————
 15392                 8)1480
   195                 ——————
 ——————                  185 Pence.
12)15577
 ——————
2|0)129|8 1
 ——————
```

Anſwer £.64 18 1 Sterling money due for 296 dollars, at 52*d.* $\frac{5}{8}$ ſterling *per* dollar.

But Ducats, Dollars, Crowns, Millreas, &c. are more expeditiouſly caſt up by the Rules of Practice hereafter to be explained.

And ſo much for Reduction. The next rule in arithmetic is,

The GOLDEN RULE, or RULE of THREE.

IT is called the GOLDEN RULE from its great uſe, not only in arithmetic, but in moſt parts of the mathematics.

It is likewiſe called the RULE of THREE, becauſe from three numbers given, we find out a fourth, which bears the ſame proportion to the third number, as the ſecond doth to the firſt; from whence alſo it is called the RULE of PROPORTION.

And of this Proportion there are two ſorts: one called Direct; the other, Indirect or Reverſe.

Direct Proportion is when the ſecond and third numbers are to be multiplied together, and their product divided by the firſt.

Indirect or Reverſe Proportion, is, when the firſt and ſecond numbers are to be multiplied together, and their product divided by the third

In Direct Proportion, the fourth number contains the third, as often as the ſecond contains the firſt.

But in Indirect Proportion, the greater the third number is, the leſs is the fourth; and the leſs the third number is, the greater is the fourth.

The ſtating the Queſtion.

The chief difficulty that occurs in the Rule of Three, is the right placing the numbers, or ſtating the queſtion; for when that is done, you have nothing more to do, but to multiply and divide, and the work is finiſhed.

And in order to ſtate the queſtion right, you muſt remember, that of the three given numbers, two of them are always of one name or denomination, and the other number is ever of the ſame name with the fourth number or anſwer required; and muſt always be the ſecond or middle number: and the number that aſks the queſtion, muſt ſtill poſſeſs the third place, and the other number of the ſame name with the third, muſt be the firſt number; for the firſt and third numbers muſt always be of one name, *viz.* both money, both weight, both time, or both meaſure. And though they be of one kind, yet if one of them is altered, by Reduction, from a higher to a lower name, then the other muſt be reduced to the ſame name. For you muſt particularly *Note*, That if either the firſt or third numbers conſiſt of ſeveral denominations, that is, of pounds and ſhillings; or pounds, ſhillings, and pence; or of pounds, ſhillings, pence, and farthings; or of tuns, hundreds, quarters, and pounds, &c. then muſt they be reduced to the loweſt name mentioned. And if any one happens to be of divers denominations, and the other but of one name; then the number of one name muſt be reduced as low, or into the ſame name with the other. As ſuppoſe the firſt number is brought into farthings, then the third number though but pounds, muſt be brought into farthings alſo. Then you are to multiply the ſecond and third numbers together, (when the proportion is direct) and divide the product by the firſt number, and the quotient thence ariſing will be the anſwer to the queſtion, and in the ſame name with the middle number: And if in a ſmall denomination, it muſt be brought by Diviſion to the higheſt name, for the better underſtanding the anſwer. You muſt alſo *Note*, that if the middle number be of ſeveral denominations, it muſt be brought into the loweſt mentioned.

Example 1. *If* 8 *yards coſt* 16*s. what will* 24 *yards coſt?*

```
8      16     24
              16
              ——
              144
              24
              ——
            8)384 (48s. or 2l. 8s. anſwer.
              ——
```

Proof of the foregoing queſtion.

If 24 *yards coſt* 48*s. what will* 8 *yards coſt?*

```
24     48    8
        8
       ——
   24)384 (16s. anſwer.
      24.
      ——
      144
      144
      ——
```

Example 2. *What is the intereſt of* 75 *pounds, at the rate of* 8 *pounds* per cent. per annum?

The numbers when placed according to the above directions, will be ſtated thus:

100 8 75

In this example there are two numbers that are principal money, and one that is intereſt; therefore the intereſt (according to the rule) muſt ſtand in the middle, or ſecond place, the principal on which the intereſt dependeth, *viz.* 100 (8*l.* being the intereſt thereof) muſt ſtand in the firſt place towards the left hand, and the other principal on which the fourth number (which is the number ſought) depends, muſt poſſeſs the firſt place towards the right-hand.

By the foregoing rules, you may with eaſe and certainty perform any operation in direct proportion, and for your farther information, take the examples following.

Example 3: *If the intereſt of* 100l. *for one year be* 8l. *what is the intereſt of* 75l. *for the ſame time?*

100 8 75
8

1 | 00)6 | 00 (6*l.* for anſwer.

Example 4. *If* 32 *rundlets of Brandy coſt* 96l. *what will* 4 *rundlets coſt at that rate?*

Run. *l.* *Run.*
32 96 4
4

32)384(12*l.* anſwer.
64

0 Remains.

Example 5. *If* 12 *bags of Cotton Wool coſt* 184*l.* *what will* 17 *bags coſt?*

Bags.	*£.*	*Bags.*			
12	184	17	*l.*	*s.*	*d.*
	17		260	13	4 Anſwer.

1288
184

12)3128(260*l.*
..

72

8 Pounds remain.
20 Shillings multiply.

12) 160 (13 Shillings.
..

40

4 Shillings remain.
12 Pence multiply.

12) 48 (4 Pence.

0 Remains.

Note, That as in the laſt example, when any thing remains that is reducible to a lower denomination, after it is ſo reduced, it muſt be divided continually by the firſt number.

Caſe.] When any of the three numbers given happen to be of divers denominations.

Rule.] You may reduce them into the loweſt denomination. And if your firſt number require to be reduced, your third muſt be reduced likewiſe into the ſame denomination as the firſt; for the firſt and third number, as I have already ſaid, muſt be always of one name or denomination.

Example 1. *If 17 hogſheads of Sugar coſt* 320l. 12s. *what will 5 of thoſe hogſheads be worth?*

Hhds. *l.* *s.* *Hhds.*
17 320 12 5
20

6412 Shillings. } Multiply.
5 Hhds.

s. *l.* *s.* *d.* *q.*
17)32060 2 | 0)188 | 5 (94 5 10 2$\frac{6}{17}$
....
8

150
0 Remains.

146

100

15 Shillings remain. } Multiply.
12 Pence in a ſhilling

30
15

17)180 (10 Pence
10 Pence remain
4 Farthings in a penny

17) 40 (2 Farthings.
6 Farths. remain to be divided 17.

Note, That when you have multiplied the ſecond and third numbers together, and divided the product by the firſt, the quotient is of the ſame denomination, as the ſecond number is, after you have reduced it (as in the laſt example) into its loweſt denomination given.

Example 2. *If* 4 C. 1 qr. 14 ℔. *of Sugar coſt* 14l. *what will* 18 C. *coſt?*

C.	qr.	lb.	*l.*	C.
4	1	24	14	18

4
4
——
17
28
——
140
36
——
500 ℔. of Sugar.

18
112
——
36
18
18
——
2016 ℔. of Sugar. } Multiply.
14*l.* Sterl. }
——
8064
2016
——
l. *s.* *d.* *q.*
5 | 00)282 | 24 (56 8 11 2 $\frac{40}{500}$ Anſw.
..
——
32
——
224 Pounds remain } Multiply.
20 Shillings in 1*l.* }
——
5 | 00)44 | 80 (8 Shillings.
..
——
480 Shillings rem. } Multiply.
12 Pence in 1*s.* }
——
960
480
——
5 | 00)57 | 60 (11 Pence.
5.
——
7
——
260 Pence rem. } Multiply.
4 Farths. in 1*d.* }
——
5 | 00)10 | 40 (2 Qrs.
10
——
40 farthings remain to be divided by 500.

Note farther, That as the farthings which remain to be divided by the common diviſor (as in the laſt example) can be reduced into no lower denomination, you may place them over your diviſor, as fractions of a farthing, which ſhall be explained when we come to Vulgar Fractions, &c.

Caſe.] When the firſt of the three given numbers is but an unit, the operation is performed by multiplication only.

Example 1. *If I give* 15s. *for a pound of Tea, what will* 250 ℔. *coſt me at that rate?*

```
lb.   s.   lb.
 1    15   250
            15
          ----
          1250
          250
          ----
          3750 Shillings anſwer, or 187l. 10s.
```

Example 2. *At* 14l. 10s. 6d. *per bag of Hops, what coſt* 55 *bags?*

```
Bag.   l.  s. d.   Bags.
 1     14  10 6    55
       20
      ---
      290 Shillings.
       12
      ---
     3486 Pence          }
       55 the 3d number. } Multiply.
    -----
    17430
   17430
   ------
   191730 Pence anſw. or 798l. 17s. 6d.
```

Caſe.] When the third of the three given numbers, is an unit, the operation is performed by diviſion only, if the work need no reduction.

Example 1. *If* 40 *pieces of Broad Cloth coſt* 500l. *what will* 1 *piece coſt?*

Pieces. *l.* Piece.
40 590 1
4|0)59|0 (14$\frac{3}{4}$ or 14*l.* 15*s.*
4 Anſwer.
19
30 Pounds remain.

Example 2. *If* 14 *hogſheads of Tobacco, nett weight* 9285℔. *coſt* 619l. 10s. *what will* 1℔. *coſt at that rate?*

℔. l. s. ℔. s. d. q.
9285 619 10 1 Anſwer 1 4 0$\frac{486}{9285}$
20
9285)12390*s.* (1 Shilling.
3105 Shillings remain.
12
9285)37260*d.* (4 Pence.
120 Pence remain.
4
480 farthings remain to be divided by 9285.

Example 3. *If one buſhel of Oats coſt* 3s. 6d. *what will a Laſt, or* 10 *Quarters coſt at that rate?*

Firſt reduce the 3*s.* 6*d.* into Pence, that is 42*d.* and the ten quarters, into buſhels, that is 80, and ſet the queſtion thus:

If one buſhel coſt 42*d.* what will 80 buſhels coſt?
80
———
3360
———

The firſt number 1 will neither encreaſe by multiplication, nor diminiſh by diviſion; therefore bring the 3360*d.* into ſhillings by dividing by 12 as follows:

12)3360 (280 ſhillings.   2|0 28|0 (14*l.*

For the proof of this, and the like Queſtions, reduce the anſwer into pence, to know whether the operation be right, as appears in the work.

14*l.*
20
———
280
12
———
3360

Example 4. *If a chaldron of Coals (that is* 36 *buſhels) coſt* 22s. *what will* 1 *buſhel coſt?*

Reduce the 22*s*. into pence by reduction, which makes 264*d*. which divide by 36 thus:

Now the remainder 12 being the third part of the diviſor 36, ſhews the part of a penny to be $\frac{1}{3}$, ſo that a buſhel at 22*s*. a chaldron, will coſt 7*d*. and a third part of a penny.

```
36)264 (7d.  12
   252        —
   ———       36
    12
   ———
```

Example 5. *If I pay* 432l. *for* 525 *quarters of Malt, what is the price of* 1 *quarter after that rate?*

Which being properly ſtated will ſtand thus:

If 525 quarters coſt 432*l*. what will 1 quarter coſt?

In this queſtion you cannot multiply the ſecond number by the third, becauſe the third number is but one.

Therefore, to perform this queſtion with eaſe, reduce 432*l*. into farthings; it makes 414720 farthings, divide this by 525, the quarters of malt, and the quotient, or the anſwer, is 789 farthings; the remainder, after the diviſion is ended, is but the parts of a farthing.

Laſtly, The 789 farthings being reduced, are 16*s*. 5*d*.$\frac{1}{4}$, therefore, if 525 quarters of malt be ſold for 432*l*. one quarter will coſt 16*s*. 5*d*.$\frac{1}{4}$ after that rate. Or, which is better, reduce the 432*l*. into ſhillings, and it gives 8640, which divide by 525, and the quotient is 16, and the remainder 240; which multiply by 12, the product is 2880; which divide by 525, the quotient is 5 pence, and the remainder 255; that multiplied by 4, the product is 1020, which divided as before gives 1 farthing, and $\frac{495}{525}$ parts of another farthing.

Example 6. *If a grocer buys* 5C.$\frac{3}{4}$ *weight of Nutmegs, which coſt him* 163l. 13s. 8d. *how may he ſell* 1 ℔. *weight without gain or loſs?*

Reduce the money into pence, it makes 39284*d.* for the dividend, and 5C.$\frac{3}{4}$ weight into pounds weight, by reduction, makes 644 pounds weight for the diviſor; then divide the 39284 by 644, and the quotient gives 61 pence, the price of one pound, *viz.* 5*s.* 1*d.*

Note, That whatever ſum of money you deſire to gain, add it to the price, and work as above, to know what the price of one pound will be; ſo will you know what you will get by every ſingle pound.

Example 7. *If* 28 *quarters of Barley coſt* 30l. 10s. 6d. *tell me what* 84 *quarters come to at that rate?*

```
If 28 qrs. coſt 30l. 10s. 6d. what will 84 qrs. coſt?
                   20                          12
                  ———      28)615384   (21978 Pence.
       Shillings 610          56          ————
                  12          ——     2|0)183|1—6
                  ——          55         —————
          Pence 7326          28         £.91 11 6
                  84          ——         —————
                ————         273
               29304         252
              58608          ——
              —————          218
          Sum 615384         196
              ——————         ———
                             224
                             224
                             ———
                              00
                             ———
```

84 Quarters come to 91*l*. 11*s*. 6*d*.

20

For a proof I reduce the 91*l*. 11*s*. 6*d*. into pence.

831

21978

Example 8. *If* 50l. 8s. *be paid for* 112 *yards, how much is that for* 7 *yards?*

Note, The 50*l*. 8*s*. being reduced into ſhillings, the queſtion will ſtand thus:

If 112 yards coſt 1008*s*. what will 7 yards coſt?

7

112)7056·63*s*. Anſw.

672

336

336

0

The Rule of Three Inverſe, or Indirect Proportion.

WHAT *Indirect Proportion* is, has been hinted already.

In *Direct Proportion,* the product of the firſt and fourth numbers, is equal to the product of the ſecond and third.

But in *Indirect Proportion,* the product of the third and fourth numbers is equal to the product of the firſt and ſecond.

The method of ſtating any queſtion in this rule, is the ſame with that in the *Direct Proportion.*

For the firſt and third numbers muſt be of one name, and ſo reduced, as in that rule; and the number that aſks the queſtion muſt poſſeſs the third place; and the middle number will be of the ſame name with the anſwer, as it is there.

To know when the queſtion belongs to the Direct, *and when to the* Reverſe Rule.

When the queſtion is ſtated as above-ſaid, conſider whether the anſwer to the queſtion ought to be more or leſs than the ſecond number; if more, then the leſſer of the two extreme numbers muſt be your *Diviſor.*

But if leſs, then the greater of the two extreme numbers muſt be your *Diviſor.*

And if the firſt number of the three is your *Diviſor,* then the *Proportion* is *Direct;* but if the laſt of the three is your *Diviſor,* the *Proportion* is *Indirect* or *Reverſe.*

Or without regard either to *Direct* or *Reverſe:*

$$\left.\begin{array}{l}\text{If more is required, the leſſer;}\\ \text{If leſs, the greater;}\end{array}\right\}\text{is the } \textit{Diviſor.}$$

Example 1.

If 4 men plane 300 deal-boards in 6 days; how many men will plane them in two days?

If 6 days require 4 men, what 2 days? *Anſ.* 12 men.

```
           6
     ---------
     2)   24
     ---------
          12 Anſ.
```

Example 2.

If a board be 9 Inches broad, how much in length will make a ſquare foot?

```
    In B.           In L.
If  12 ————————————— 12, what 9 inches broad?
                     12
        ------------------
        9)          144
        ------------------
   Anſwer 16 Inches in length.
```

In theſe examples, the firſt and ſecond numbers are multiplied together, and the product is divided by the third; for, in the firſt example, it is moſt certain, that 2 days will require more hands to perform the work than 6 days; therefore the leſſer of the extreme numbers is the *Diviſor*; and declares the queſtion to be in the *Indirect Proportion*.

Likewiſe, in the ſecond example, 9 inches in breadth, muſt needs require more in length to make a foot, than 12 inches in breadth; wherefore it is in the ſame *Proportion* with the firſt example, becauſe the *Diviſor* is the third number.

Example 3.

How many yards of Silk, of 3 *qrs.* wide, will line 9 yards of Cloth, of 8 *qrs.* wide?

Qrs. wide. *yds. long.* *qrs. wide.*
If 8———————9 what———————3
8
Here the narrower the Silk, the more in length is required.
———
3) 72
———
Yards 24 *Anſwer.*

Example 4.

If a quartern Loaf weigh 5 ℔. when wheat is 6*s.* the buſhel, what muſt it weigh when Wheat is 4*s.* the buſhel?

s. *lb.* *s.* *lb.*
If 6———————5———————4 Anſwer $7\frac{2}{4}$ or $\frac{1}{2}$
6
———
4)30 ($7\frac{2}{4}$
28
———
2
———

Example 5.

If in 12 months 100*l.* principal, gain 5*l.* intereſt, what principal will gain the ſame intereſt in 4 months?

12 ———————100———————4 Anſwer 300*l.*
12
———
4)1200 (300*l.* principal.
12
———
0

The Double Rule of Three Direct.

In this rule there are five numbers given to find out a ſixth, which ſixth muſt bear the ſame proportion to the product of the fourth and fifth numbers, as the third does to the product of the firſt and ſecond numbers.

The Rule for ſtating the five Numbers given is;

Make that the third number from the left hand, which is of the ſame denomination with the number ſought; then place the two numbers in the firſt and ſecond place to the left hand, which are conjunctive in the ſenſe of the queſtion to the third, and the other two numbers in ſuch order, that the fourth may be of the ſame denomination with the firſt, and the fifth of the ſame with the ſecond: Which done,

Rule.] Divide the product of the three next the right hand, multiplied one in another, by the product of the two next the left hand, and the quotient is the fixth number ſought for.

Example. *If* 100l. *in* 12 *months gain* 6l. *intereſt, what will* 500l. *gain in* 8 *months?*

	L.H.	*Months.*	*L.I.*	*L.P.*	*Months.*
	100	12	6	500	8
	12			6	
Diviſor	1200			3000	
				8	

12 | 00)240 | 00(20*l.* Anſ.
24
00 Remains.

By the work you may perceive that 500*l.* will gain 20*l.* in 8 months, at the rate of 100*l.* Principal gains 6*l.* intereſt in 12 months.

This queſtion, or any other of the ſame nature, may be reſolved by two operations, in the Single Rule of Three Direct, thus:

If 100l. *produce* 6l. *what will* 500l. *produce?* The anſwer is 30*l.*

Then ſay, *If* 12 *months require* 30l. *what will* 8 *months require?* The anſwer, as before, is 20*l.*

The Double Rule of Three Inverſe.

The Rule *for ſtating your* Queſtion.

Place the three firſt numbers toward the left hand, in the ſame order you did in the laſt rule: And for the other two, place that the fourth, which is of the ſame denomination with your ſecond number, and conſequently the other next the right hand; So will your firſt and laſt, *viz.* that required, be of one denomination, your ſecond and fourth of another, and your third and fifth of another: And,

The Rule for performing the Operation is,

Divide the product of the firſt multiplied into the ſecond, and that product into the fifth, by the product made of the third and fourth, and the quotient is the anſwer.

Example. *What principal will raiſe* 20l. *in* 8 *months, at* 6 per cent. per annum.

L. P.	*Months.*	*L. I.*	*Months.*	*L. I.*
100	12	6	8	20
12		8		
1200		48 your diviſor.		
20				

L. In.

48) 24000 (500 quotient for anſwer; which proves the laſt operation.

0 Remains.

Before we leave the Rule of Three, it may be proper to obſerve, that when four numbers are in ſuch proportion to one another, that the firſt is to the ſecond as the third is to the fourth, they will continue to hold the ſame proportion, even when their order is changed a variety of ways, by what is uſually called *Alternation*. Here follows an Example,

2 : 4 :: 6 : 12
2 : 6 :: 4 : 12
4 : 2 :: 12 : 6
12 : 6 :: 4 : 2
6 : 2 :: 12 : 4
4 : 12 :: 2 : 6
12 : 4 :: 6 : 2
6 : 12 :: 2 : 4
2 × 4 : 4 :: 6 × 12 : 12
2 × 6 : 6 :: 4 × 12 : 12
4 × 2 : 2 :: 12 × 6 : 6
12 × 6 : 6 :: 4 × 2 : 2
6 × 2 : 2 :: 12 × 4 : 4
4 × 12 : 12 :: 2 × 6 : 6
12 × 4 : 4 :: 6 × 2 : 2
6 × 12 : 12 :: 2 × 4 : 4
4 — 2 : 4 :: 12 — 6 : 12
6 — 2 : 6 :: 12 — 4 : 12
12 — 4 : 12 :: 6 — 2 : 4
12 — 6 : 12 :: 4 — 2 : 6

× That is, *Plus*, or added to.

— That is, *Minus*, or ſubtracted from.

Thus we ſee, that theſe numbers, in all the various forms in which they are here placed, ſtill retain the ſame proportion to one another: that is, the product of the two extreme numbers is equal to the product of the two mean numbers; in other words, the firſt and laſt numbers multiplied into each other, produces the ſame ſum, as the ſecond and third number multiplied into each other.

Arithmetical PROGRESSION.

IS when a rank or ſeries of numbers differ orderly from one another, by ſome common number.

To find the ſum of any Arithmetical progreſſion, add the firſt and laſt numbers together, and multiply that ſum by half the number of places, and that product is the ſum. But if the number of places be odd, multiply the ſaid number of places by half of the firſt, and laſt added, and that product is the ſum.

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.

What the ſum.

16 Laſt.
1 Firſt.
—
17 Sum.
8 Half of the number of places.
—
136 Sum of the whole.
—

Suppoſe a man hires a room for a year, and agrees to pay the firſt week 5d. *the ſecond week* 9d *and for the third week* 13d. *ſo paying every week* 4d *more until* 52 *weeks, or a year is finiſhed, I demand what the rent will come to?*

Anſwer 23*l.* 3*s.* 8*d.*

Here you are to conſider, that the common increaſing number is 4*d.* ſo that the laſt week muſt amount to 51 times 4, added to the pay of the firſt week, which is 5*d.* then will the laſt week come to 209 pence; then work as in the example.

51
4
Product 204
5
Added 209 the laſt week
5 the firſt week.
Added 214
26 Half the weeks in the year,
1284
428
Pence 5564

12)5564(463*s.*
48
76
72
44
36
8*d.*

2 | 0)46 | 3(23*l.* 3*s.* 8*d.*

Geometrical Progreſſion.

IS when a ſeries of numbers increaſes in ſuch a manner, that every ſucceeding number is double, triple, quadruple, or other certain ratio of that which precedes it.

Suppoſe one ſold 12 *ells of cloth, to receive for the firſt ell* 1d. *for the ſecond* 2d. *the third* 4d. *and ſo doubling, what is paid for the* 12 *ells?*

0, 1, 2, 3, 4, 5, 6.
1, 2, 4, 8, 16, 32, 64
32
128
192
2048
2
Anſwer 4096 Pence.

Note, That if this queſtion had been for a farthing a button, or the like, the anſwer would have been farthings.

Suppoſe one ſold a horſe having 4 *ſhoes, and in every ſhoe* 6 *nails, to recive for the firſt nail* 1 *farthing, the ſecond nail* 2 *farthings, the third nail a penny, and ſo doubling, how much is paid for the laſt nail, and the price of the horſe?* Anſwer 17476*l.* 5*s.*

```
0, 1, 2, 3, 4, 5, 6,  7,  8,   9,   10,   11,   12,
1,2,4,6,8,16,32,64,128,256,512,1024,2048,4096
                                         4096
                                     --------
                                        12288
                                       18432
                                      81920
                                     --------
                                      8388608
                                            2
                                     --------
                           Farthings 16777216
                                     --------
```

Or if this queſtion had been of a coat ſold at a barley-corn a button, and ſo doubling to 24 buttons, (accounting 900 corns to a pint) I divide the 16777216 by the 900 corns, the quotient gives about 18641 pints, which divide by 64, the pints in a buſhel, the quotient gives about 292 buſhels, or about 36 quarters of barley for the coat.

The Rule of FELLOWSHIP *or* COMPANY,

MAY be fitly divided into *Gain*, *Loſs*, and *Time*.

A General Rule.

As general ſtock to general profit bears,
So each man's ſtock in general profit ſhares.

That is to ſay,

Every man's particular ſtock being added together, the total muſt be the firſt number in the rule of three; the gain is the ſecond, and every man's particular ſtock the third; as,

Suppoſe two merchants in company A. *laid in* 20l. B. *laid in* 40l. *whereby was gained* 50l. *what is each man's part of the gain?*

A. 20
B. 40
60

If 60*l.* gain 50*l.* what will 20*l.* gain?
20
6 | 0)100 | 0 (16*l.* 13*s.* 4*d.*
6
40
36
4

If 60*l.* gain 50*l.* what will 40*l.* gain?
40
6 | 0)200 | 0 (33*l.* 6*s.* 8*d.*
18
20
18
2

	l.	*s.*	*d.*
	33	06	8
	16	13	4
Proof	50	00	0

Suppoſe two merchants made a ſtock, A. *laid in* 45l. *and* B. *laid in* 68l. *whereby was gained* 32l. *how muſt the gains be divided?*

If 113*l.* gain 32*l.* what will 45*l.* gain?

A. 45
B. 68
———
113

45
———
160
128
———
113)1440 (12*l.* $\frac{84}{113}$ *A*'s part
113
———
310
226
———
84
———

If 113*l.* gain 32*l.* what will 68*l.* gain?

68
———
256
192
———
113)2176 (19*l.* $\frac{29}{113}$ *B*'s part.
113
———
1046
1017
———
29
———

The 29 of the fraction multiplied by 240, (the pence in 20*s.*) and the product divided by 113, the quotient tells the pence.

Suppoſe three merchants, A. B. *and* C. *join their monies to make a ſtock of* 25000l. *of which* A. *laid in* 10000l. B. 8000l. C. 7000l. *with this (after a certain time of trading) they gained* 7500l. *how muſt this be parted?*

If 25000*l.* gain 7500*l.* what will 10000*l.* gain?

```
                 10000
            -------------
25 | 000)75000 | 000 (3000l. A's part.
         75
         ------------
         00000
```

If 25000*l.* gain 7500*l.* what will 8000*l.* gain?

```
                  8000
            -------------
25 | 000)60000 | 000 (2400l. B's part.
         50
         ---
          100
          100
         ---
            0
```

If 25000*l.* gain 7500*l.* what will 7000*l.* gain?

```
                 7000
            -------------
25 | 000)52500 | 000 (2100l. C's part.
         50
         ---       A. 3000l. \
          25       B. 2400l.  } Stocks added.
          25       C. 2100l. /
         ---       ---------
           0         7500
```

Rule of FELLOWSHIP *with Time.*

The RULE,

EVERY man's ſtock muſt be multiplied by his time, and the total of thoſe products, added together is the firſt number, the gain or loſs the ſecond number, and the product of every man's particular ſtock and time the third number.

Suppoſe two merchants in company. A. *laid in* 100l. *for* 4 *months*; B. *put in* 136l. *for* 3 *months, and they gained* 50l. *what is each man's part?*

$$\left.\begin{array}{l} A.\ \text{put in } 100l. \\ B.\ \text{put in } 136l. \end{array}\right\}\text{Multiplied by}\left\{\begin{array}{c} 4 \\ 3 \end{array}\right\}\text{give}\left\{\begin{array}{r} 400 \\ 408 \\ \hline 808 \\ \hline \end{array}\right.$$

If 808*l.* gain 50*l.* what will 400*l.* gain?

```
        400
      -----
808)20000  24l. 608/808 A's part.
    1616
    -----
     3840
     3232
    -----
      608
```

If 808*l.* gain 50*l.* what will 408*l.* gain.

```
        408
      -----
        400
      2000
      -----
808(204000  (25l. 200/808 B's part.
    1616
    -----
     4240
     4040
    -----
      200
```

Suppoſe three butchers, A. B. *and* C. *held a paſture, for which they pay* 45l. per annum, A. *hath* 24 *oxen* 32 *days,* B. *hath* 12 *there* 48 *days, and* C, 16 *oxen there* 24 *days, what muſt every man pay of the rent?*

$$\begin{array}{ll} & \text{Oxen.} \\ A. & 24 \\ B. & 12 \\ C. & 16 \end{array}\left.\vphantom{\begin{array}{l}1\\1\\1\end{array}}\right\}\text{Multiplied by}\left\{\begin{array}{c}\text{Days.}\\32\\48\\24\end{array}\right\}\text{give}\left\{\begin{array}{r} \\ 768\\576\\384\\ \hline 1728 \end{array}\right.$$

If 1728*l.* give 45*l.* what will 768*l.* give?

$$\begin{array}{lr} 1728)34560\ (20l. & 768 \\ \quad\ 3456 & 45 \\ \hline \quad\quad 00 & 3840 \\ & 3072 \\ & 34560 \end{array}$$

A. pays 20*l.* of the rent.

B. pays 15*l.* *C.* 10*l.* which makes 45*l.*

Of FRACTIONS.

Notation and Numeration of Vulgar Fractions.

A FRACTION is one or more parts of an Unit or Integer, according as the ſame is divided.

Every Fraction conſiſts of two parts, *viz.* a Numerator and a Denominator.

The Denominator, placed below the ſhort line that divides it and the Numerator, ſhews how many parts the integer or unit is divided into.

The Numerator, placed above the ſhort line, ſhews how many of the ſaid parts, expreſſed by the the Denominator, are contained in the Fraction. For inſtance:

3 Numerator.
4 Denominator.

In reading fractions, the numerator is firſt mentioned, then the denominator; as the fraction above is read, three fourth parts of any thing; *i. e.* the denominator ſhews, that the integer is divided into four parts; and the numerator, that three of thoſe four parts are contained in the fraction. So by the ſame reaſon,

$\frac{1}{4}$ is one fourth,
$\frac{1}{2}$ is one half,
$\frac{2}{3}$ is two thirds,
$\frac{5}{6}$ is five ſixths,
$\frac{6}{7}$ is ſix ſevenths,
$\frac{7}{8}$ is ſeven eighths,
$\frac{8}{9}$ is eight ninths,
$\frac{9}{10}$ is nine tenths, &c.

Fractions are either proper or improper.

A fraction, properly ſo called, or a proper fraction, is when the numerator is leſs than the denominator, as the fractions foregoing.

An improper fraction is, when the numerator is greater than the denominator, $\frac{7}{4}$, $\frac{28}{20}$, *&c.* Again,

Fractions are either ſimple or compound.

A ſimple fraction is, when the fraction is immediately the fraction of an unit or integer; as thoſe abovementioned.

A compound fraction is a fraction of a fraction, as $\frac{1}{2}$ of $\frac{1}{4}$ of a pound ſterling, which is equal to 2*s*. 6*d*. Or it is when an unit is divided into a number of parts, and each of thoſe parts again ſubdivided into other parts.

Reduction of Vulgar Fractions.

It may ſeem ſtrange to ſome that reduction is here taught before addition, &c. but it is neceſſary it ſhould be ſo, becauſe reduction is made uſe of in all the ſubſequent rules, to fit and prepare fractions for addition, ſubtraction, &c.

Caſe 1.] When a mixt number is given to be reduced to an improper fraction.

Rule.] Multiply the integers by the denominator of the fraction, and to the product add the numerator, and place the ſum over the denominator for a new fraction.

Example. *Reduce* 12$\frac{3}{4}$ *to an improper fraction.*
See the marginal operation.

Anſwer $\frac{51}{4}$

Caſe 2.] When an improper fraction is given to be reduced to a whole or mixt number.

Rule.] Divide the numerator of the fraction by the denominator, and the quotient is a whole number; and if any thing remains, it muſt be placed over the diviſor.

Example. *Reduce* $\frac{51}{4}$ *to a whole or mixt number.*

4)51 (12$\frac{3}{4}$ Anſwer, which proves the laſt caſe.
  4
  —
  11
  —
  3 Remains
  —

Caſe 3.] When fractions have different denominators, and are to be reduced to a common denominator.

Rule.] Multiply the numerator of each fraction ſingly, into all the denominators except its own, and the product is a new numerator; and then multiply all the denominators one into another, and the product is a common denominator.

Example. ***Reduce*** $\frac{2}{3}$, $\frac{3}{4}$, ***and*** $\frac{5}{7}$ ***to a common Denominator.***

Firſt,

2 Firſt numerator.
4 Second denominator
—
8 Product. } mult.
7 Third Denom.
—
56 Firſt new numerator.

Secondly,

3 Numerator of the 2d.
3 Denominator of the 1ſt.
—
9 Product.
7 Denominator of the 3d.
—
63 Second new numerator.

Thirdly,

5 Numerator of the 3d.
4 Denominator of the 2d.
—
20 Product.
3 Denominator of the 1ſt.
—
60 Third new numerator.

Laſtly,

3 } Multiply } Denominators.
4
—
12 } Multiply
7
—
84 Common denominator.
—

Now if you place each new numerator over the common denominator, you will have

$$\left.\begin{array}{l}\frac{56}{84}\\ \frac{63}{84}\\ \frac{60}{84}\end{array}\right\}\text{Equivalent to}\left\{\begin{array}{ll}\frac{2}{3} & \text{The firſt fraction given.}\\ \frac{3}{4} & \text{The ſecond fraction.}\\ \frac{5}{7} & \text{The third fraction.}\end{array}\right.$$

Caſe 4.] To reduce a fraction to its loweſt terms.

Rule.] Take $\frac{1}{2}$, $\frac{1}{3}$, or $\frac{1}{4}$, &c. of the numerator and denominator.

Example. *Reduce* $\frac{56}{84}$ *to its loweſt terms.*

Say, half of 56 is 28, and $\frac{1}{2}$ of 84 is 42; the $\frac{1}{2}$ of 28 is 14, and $\frac{1}{2}$ of 42 is 21; and becauſe you cannot take half, $\frac{14}{21}$ make trial if you can take $\frac{1}{3}$. *&c.* but ſince you can only take $\frac{1}{2}$ of both, ſay, the 7's in 14 is 2, and the 7's in 21 is 3, ſo is the given fraction equivalent to $\frac{2}{3}$, and proves the firſt fraction in the laſt caſe to be right.

$\frac{56}{84}$ or	$\frac{28}{42}$ or	$\frac{14}{21}$ or	$\frac{1}{3}$
Take $\frac{1}{2}$	Take $\frac{1}{2}$	Take $\frac{1}{7}$	Loweſt Term.

Caſe 5.] To reduce a compound fraction to a ſimple one, equivalent to the compound.

Rule.] Multiply all the numerators one into another, for the numerator of the anſwer, and the denominators one into another for that of the anſwer.

Example. *Reduce* $\frac{1}{4}$ *of* $\frac{1}{12}$ *of* $\frac{1}{20}$ *into a ſimple fraction.*

The product of the denominators, 4, 12, and 20, is 960, and the product of 1, 1, and one is 1; ſo the ſimple fraction ſought for is $\frac{1}{960}$.

Caſe 6.] To find the value of any fraction, whether the ſame be of coin, meaſure, weight, &c.

Rule.] Multiply the numerator of the fraction by ſuch a number of units of the next inferior denomination, as is equal to an unit of the denomination the fraction is part of, and divide the product by the Denominator, ſo the quotient will anſwer your queſtion; but if any thing remain, reduce that to the next lower denomination and divide as before.

Example. *What is the value of* $\frac{134}{146}$ *of a hundred weight?* See the operation.

134 Hundred.
4 Quarters in a Hundred. } Multiply

146)536 (3 Quarters of a Hundred.
438

98 Quarters remain.
28 Pounds in a Quarter. } Multiply

784
196

146) 2744(18 Pounds
146

1284
1168

116 Pounds remain.
16 Ounces in a Pound. } Multiply

696
116

146)1856(12 Ounces.
146

396
292

104 Ounces remain.
16 Drams in an Ounce. } Multiply

624
104

146)1664 (11 Drams $\frac{58}{146}$
146

	Q.	℔.	oz.	dr.
Answer	3	18	16	11 $\frac{58}{146}$

206
146

58

Caſe 7.] To reduce fractions of a lower denomination to thoſe of a higher.

Rule.] Conſider what denomination your fraction is of, and how many of that make a unit of the next, &c. to the denomination you would have your fraction reduced to; then work as in the ſixth caſe of this chapter.

Example. *Reduce* $\frac{1}{5}$ *of an ounce Avoirdupois to the fraction of an hundred weight.*

Caſe 8.] When you would reduce a fraction of a higher to a fraction of a lower denomination;

Rule.] Reduce the numerator of the fraction into that denomination you would have your fraction of, and place it over the denominator given for a new fraction.

Example. *Reduce* $\frac{1}{8900}$ *of a hundred weight to a fraction of an Ounce.*

112 Pounds. } Multiply
16 Ounces in a pound. }

672
112

Product 1792 Ounces in the Numerator: So the Anſwer is $\frac{1792}{8960}$; which fraction in its loweſt term is $\frac{1}{5}$, and proves the laſt caſe. See the work.

$\frac{1792}{8960}$, $\frac{896}{4480}$, $\frac{448}{2240}$, $\frac{112}{566}$, $\frac{56}{280}$, $\frac{8}{40}$, $\frac{1}{5}$

Take $\frac{1}{2}$ Take $\frac{1}{7}$ Take $\frac{1}{2}$ Take $\frac{1}{2}$ Take $\frac{1}{2}$ Take $\frac{1}{2}$.

Proof, or more brief by dividing the firſt by 1792.

Addition of Vulgar Fractions.

CASE I.

WHEN a ſimple fraction is to be added to a ſimple fraction.

RULE.

If the fractions to be added have a common denominator, add the numerators together for a numerator, and place it over the common denominator.

EXAMPLE.

Add $\frac{2}{5}\frac{3}{5}$, and $\frac{4}{5}$ of a pound ſterling together. Say, 2 and 3 is 5, and 4 is 9, the numerator; which place over 5 the common denominator, thus $\frac{9}{5}$; and this improper fraction $\frac{9}{5}$, is in value of 36*s.* for 9 times 4*s.* (the 5th of a pound) is 36*s.* for if the numerator 9, be divided by the denominator 5, I ſay the 5's in 9, once, and 4 remains, which is $\frac{4}{5}$ of a pound, or 16*s.*

$$\begin{array}{r} 5)9 \\ \hline l.\ 1\frac{4}{5} \end{array}$$

But if the fractions to be added have not a common denominator, they muſt be reduced to one, by the third rule above-mentioned, before addition can be performed; and then proceed as above.

Caſe 2.] When a mixed number is to be added to a mixed.

Rule.] Work with the fractional parts as before, and afterwards add the ſum of the fractions to the ſum of the integers, and you have your deſire.

Example. *To* 1 $\frac{1}{2}$ *add* 74 $\frac{3}{5}$.

The ſum of the fractions by the laſt caſe is, 1 $\frac{7}{10}$, which added to 1 and 74 make 76 $\frac{1}{10}$.

$$\begin{array}{l} 76\ \frac{1}{10} \\ \hline \left.\begin{array}{l} 1\ \frac{1}{10} \\ 1 \end{array}\right\}\text{Add} \\ 74 \\ \hline 76\ \frac{1}{10}\ \text{the ſum required.} \\ \hline \end{array}$$

Or you may perform the work, by reducing the given numbers to improper fractions; and ſo proceeding as formerly directed.

Caſe 3.] When a compound fraction is to be added to a ſimple one.

Rule.] Reduce the compound fraction to a ſimple one by your former directions; then find out the ſum.

Example. *To* $\frac{15}{42}$ *add* $\frac{3}{8}$ of $\frac{2}{3}$.

The compound fractions reduced to a ſingle one is, $\frac{6}{24}$ or $\frac{1}{4}$.

The common denominator of $\frac{1}{4}$ and $\frac{15}{42}$, is as follows, $\frac{42}{168}$ and $\frac{60}{168}$.

The ſum of the numerators is 102, ſo that $\frac{102}{168}$ is the Anſwer.

Subtraction of Vulgar Fractions.

Caſe 1.] When a ſimple fraction is to be deducted from a ſimple one.

Rule.] Reduce the fractions to a common denominator as before; then take the numerator of the ſubtrahend from the other, and place the remainder over the common denominator, and you have the difference ſought.

Example. *From* $\frac{3}{4}$ *take* $\frac{5}{12}$, See the work.

36 the firſt numerator. 48 the common denominator
20 the ſecond numerator.

16 difference. Anſwer $\frac{16}{48}$ or $\frac{1}{3}$.

Caſe 2.] When a compound fraction is to be deducted from a ſingle fraction.

Rule.] Reduce the compound fraction to a ſimple one, and then work as in the laſt caſe.

Example. *From* $\frac{13}{14}$ *take* $\frac{2}{3}$ *of* $\frac{8}{9}$.

The compound fraction reduced to a ſimple one is $\frac{16}{27}$.

13	16	27
27	14	14
91	64	108
26	16	27
351 the 1ſt num.	224 the 2d num.	378 the com. D.
224 deduct.		
127 remains.		

So the Anſwer is $\frac{127}{378}$.

Caſe 3.] When a ſimple fraction is to be deducted from a whole number.

Rule.] Deduct the numerator from the denominator, and place the remainder over the denominator; then deduct 1 from the integer, and place the remainder before the remaining fraction, and you have your anſwer.

Example. *From* 12 *take* $\frac{5}{8}$. The anſwer is $11\frac{3}{8}$.

Note, That the 1 borrowed from the 12 (in the firſt method) is $\frac{8}{8}$; ſo that if from $\frac{8}{8}$ you take $\frac{5}{8}$, there remains $\frac{3}{8}$.

Multiplication of Vulgar Fractions.

Caſe 1.] When you are to multiply a ſimple fraction by a ſimple one.

Rule] Multiply all the numerators one in another, for the numerator of the product, and likewiſe the denominators for the denominator of the product.

Example. *Multiply* $\frac{1}{2}$ by $\frac{2}{3}$. Anſwer $\frac{2}{6}$ or $\frac{1}{3}$.

Note. The effect of multiplication of fractions is different from that of whole numbers; for the product is always leſs than the multiplicand, though it is always greater in whole numbers; the former being the multiplying of the parts into which an unit is divided, which muſt needs make the parts produced leſs than thoſe given; the latter multiplying units, muſt needs augment the number; the former diminiſhing the parts of an unit to infinite littleneſs; the latter augmenting the number of units *ad infinitum*.

Caſe 2.] When you multiply a whole number by a fraction.

Rule.] Multiply the integer by the numerator of the fraction, and the product placed over the denominator is the anſwer; which differs nothing from the laſt caſe, if you put an unit under the integral part, making it like a fraction.

Example. *Multiply* 126 *by* $\frac{3}{7}$. Anſw. $\frac{378}{7}$ or 54.

Caſe 3.] When you multiply a ſimple by a compound fraction.

Rule.] Reduce the compound fraction into a ſimple one, and work as in the laſt caſe but one.

Example. *Multiply* $\frac{18}{19}$ *by* $\frac{5}{9}$ *of* $\frac{3}{7}$.
Anſwer $\frac{270}{1197}$ or $\frac{30}{133}$.

Diviſion of Vulgar Fractions.

Caſe 1.] When you would divide a ſimple fraction by a ſimple one.

Rule.] Having placed the dividend and the diviſor, as in the whole numbers, multiply the numerator of the diviſor, into the denominator of the dividend, for the denominator of the Quotient: And the denominator of the diviſor, into the numerator of the dividend, for the numerator of the quotient.

Example. *Divide* $\frac{11}{12}$ *by* $\frac{1}{2}$. ($\frac{1}{2}$ $\frac{11}{12}$ $\frac{22}{12}$ or 1 $\frac{5}{6}$

Note, 1. To make a fraction greater in value, is nothing but to multiply, or add, to it's numerator, or to divide or take from it's denominator.

2. To make a fraction leſs, is to multiply, or add to, it's denominator, or to divide, or take from it's numerator.

Caſe 2.] When you divide a whole number by a fraction.

Rule.] Place an unit under the whole number, and work as in the laſt.

Example. *Divide* 54 *by* $\frac{3}{7}$. See the operation.

$\frac{3}{7}$) $(^{8}\frac{7}{3}{}^{3}$ Anſwer, or 126.

Caſe 3.] When you divide a ſimple fraction by a compound fraction.

Rule.] Reduce the compound to a ſimple fraction, and work as in the laſt caſe but one.

Example. *Divide* $\frac{30}{133}$ *by* $\frac{5}{9}$ *of* $\frac{3}{7}$. The compound fraction is $\frac{15}{63}$.

$\frac{15}{63}$) $\frac{50}{133}$ nearly $\frac{1890}{1995}$ or $\frac{18}{19}$.

Reduction of Decimal Fractions.

A decimal fraction differs only from a vulgar fraction in this, that the denominator of a decimal fraction is either 10, or ſome power of 10, *viz.* 100, 1000, 10000, &c. ſo that the denominator is eaſily known without expreſſing it; for in a decimal fraction there is a point or prick towards the left-hand of the numerator; which point always poſſeſſes the ſame place, as the firſt figure towards the left hand would, if it were to be wrote down: Thus $\frac{1}{10}$ is .1, the prick being in the ten's place, and therefore denotes the denominator to be 10, $\frac{12}{100}$ is .12, $\frac{125}{1000}$ is .125, $\frac{1964}{10000}$ is .1964, &c.

The way to reduce a Vulgar Fraction to a Decimal is by this proportion.

Rule.] As the denominator of the vulgar fraction given is to it's numerator:

So is 1000,

To the numerator of the decimal whoſe denominator is 1000:

Or ſo is 10000 to the numerator of the decimal, whoſe denominator is 10000, &c.

Example. *What is $\frac{1}{8}$ in a decimal fraction?* See the operation.

8 : 1 : : 1000

1

8)1000

.125 Anſw.

But becauſe it ſometimes happens that a cypher more is to poſſeſs the 1, 2, *&c.* place of the decimal towards the left-hand, therefore take this

Rule.] As many cyphers as you have in the third number of the 3 given, as above, ſo many places muſt you prick off in the quotient toward the right-hand.

Example. *How is* 9d. *expreſſed in the decimal of a pound ſterling?*

Rule.] Conſider, that in a pound there are 240 pence; therefore 9*d.* is $\frac{9}{240}$ in a vulgar fraction; for 9*d.* is $\frac{9}{12}$ of $\frac{1}{20}$ of a pound.

Then ſay as the laſt example,

240 : 9 : : 10000

9

24|0)9000|0(.0375 Anſwer.

.180

.120

0 Remains.

In this example it is plain there are but three places in the quotient; and as by the rule there ſhould be four, prefix a cypher to the left of ſuch quotient, and prick them off for decimals. When any thing remains, four decimal places will generally be ſufficiently near the truth, and frequently three, or ſometimes two.

To find the value of a Decimal Fraction in its proper denominations.

Rule.] Conſider how many of the next inferior denomination make an unit in the denomination of the decimal, and multiply by it; pointing off as many places in the product from the right hand as are contained in the given decimal, and thoſe on the left will be whole numbers. In like manner proceed for the next lower denomination, with the decimal only of ſuch product, and ſo on, till you have brought it down to the loweſt.

Example. *What is the proper value of* .535 *of a pound ſterling?*

.535	Parts of a pound ſterling.
20	Shillings make a pound.
11.700	
12	Pence make a ſhilling.
8.400	
4	Farthings make a penny.
1.600	

Anſw. 11*s.* 8*d.* ¼. 600 parts.

Addition of Decimal Fractions.

All the difference between this and whole numbers conſiſts in placing the ſeveral parts under thoſe of the ſame value, whether they end equally at the right hand or not, as the ſeparating points muſt always be under each other; by this means the integers, or whole numbers, will always be on the left, and the decimal places on the right. Thoſe decimal places next the point will be always under each other next on the right hand; and thoſe which are two places from it will in like manner ſtand under each other, and ſo of the reſt.

Examples.

3.47	.8367	43.2
16.342	.04531	7.835
9.81	.6207	67.71
33.7	.41306	42.03
8.467	.35087	215.005
231.608	.7063	9.35
17.35	.507	25.087
320.747	3.47994	410.217

Note, That the firſt decimal place to the right hand of the ſeparating point is called tenth parts, or primes; the ſecond is called hundredth parts, or ſeconds; the next thouſandth parts, or thirds; the fourth ten thouſandth parts, or fourths; the next hundred thouſandth parts, or fifths, &c. &c.

Subtraction of Decimal Fractions.

Place the numbers as in Addition; only obſerve, that the integers or fractions greateſt in value be placed above, whether they conſiſt of more or fewer figures.

Examples.

From	63.23	81.3	171.01
Take	17.39	26.573	64.2373
Remains	45.84	54.727	106.7727

Note, That in the ſecond and third examples, where the number of decimal places in the lower line exceed thoſe in the upper, the ſubtraction is made as if they were ſupplied with cyphers.

Multiplication of Decimal Fractions.

Here the numbers muſt be placed as in whole numbers, without any regard to the ſeparating point, or to the value of the factors, and the operation performed in like manner; ſetting off as many places in the product as both factors contain for decimals; and if there are not ſufficient, prefix as many cyphers as will make them equal.

Examples.

64.7	43.27	7.635
5.9	.046	9.03
5823	25962	22905
3235	17308	687150
381.73	1.99042	68.94405

5.487	3.485	80.673
97.6	709.4	650.08
32922	13940	645384
38409	31365	40336500
49383	243950	484038
535.5312	2472.2590	52443.90384

Diviſion of Decimal Fractions.

The operation of this is the ſame as in whole numbers: then to find how many decimal places muſt be pricked off in the quotient, obſerve how many places are in the dividend, from which deduct the number contained in the diviſor, and cut off from the right hand of the quotient the number of places remaining; and if there are not ſo many in the quotient, prefix as many cyphers as are wanting.

Example. *Divide* 5473.23 by 67.857.
67.857)5473.230000(80.658
542856 ····
446700
407142
395580
339285
562950
542856
(20094)

Note, That as many cyphers are added to the dividend in this example as to make it contain three more decimal places than the diviſor, which therefore are pricked off from the right hand in the quotient.

Example. *Divide* 6.257 by 857.63.
857.63)6.2570000(.00729
600341 ··
253590
171526
820640
771867
(48773)

As one of the moſt uſeful and neceſſary parts of land ſurveying, and other kinds of meaſuring, require a knowledge of the Square Root, it may be proper to preſent that and the Cube Root, with ſome of their uſes, in this place.

EXTRACTION of the SQUARE ROOT.

TO extract the Square Root, is to diſcover the root or firſt number, of which the number given to be extracted is the ſquare, or ſecond power, produced by multiplying ſuch root or number by itſelf; as 5 by 5, 9 by 9, 27 by 27, &c.

Point the given number, whether whole numbers or decimal fractions, or both, into periods of two figures, always placing the firſt over the place of units, in whole numbers (if any), but if none, over the ſecond place, to the right hand of the decimal point, ſupplying the period with cyphers in the decimals, if wanted: then conſider what ſingle figure, multiplied by itſelf, will make the neareſt number leſs than the firſt period to the left hand, whether of one or two figures; ſo that if the firſt period be 23, then will 4 be the figure to be placed in the quotient, and that multiplied by itſelf is 16, to be put under the 23, and being ſubtracted from 23, will leave 7 for a remainder, to which bring down the firſt figure of the next period of two figures, which we will ſuppoſe to be 04, when it will be 70. For this a diviſor muſt be found, which is always thus:—double the figure, or figures, in the quotient, and put them for a diviſor, wherewith to find another quotient figure, and aſk how often ſuch diviſor is contained in that dividend, and place the figure both in the diviſor and root, and alſo bring down the other figure of that period for a full dividend. Multiply the diviſor by the laſt quotient figure, and if the product exceeds the full dividend, leſſen the quotient figure till you can ſubtract the product from it, and proceed with the remainder and the next period as with the laſt, always finding a new diviſor, till the work is done.

Note, It ſometimes happens that the product is greater than the reſpective full dividend, and yet that leſſening the quotient figure by unity ſhall occaſion the remainder to exceed the diviſor; in this caſe, the next quotient figure will commonly be 9, and the work, notwithſtanding, will proceed regularly. If, after you have gained a ſufficient number of decimals, there ſtill continues a remainder, the work may be concluded; becauſe, by adding periods of cyphers, it might be carried on without end.

Example 1. *What is the Square Root of* 2304?

```
 •  •
2304 (48 Anſwer.
16  •
----
88)704
   704
   ---
   •••
```

Example 2. *Required the Square Root of* 73549.44?

```
      •  •  •  •
      73549.44 (271.2 Anſwer.
      4
      --
   47)335
      329
      ----
  541)649
      541
      ----
 5422)10844
      10844
      -----
      •••••
```

Example 3. *What is the firſt Power or Root of* 647527.354?

```
   .  . .  . .
   647527.3540(804.69
   64
  ————————
  1604)7527
       6416
       ————
 16086)111135
        96516
       ——————
160929)1461940
       1448361
       ———————
       (13579)
```

Note, That in this example I firſt ſupply the odd figure with a cypher, to complete the period of two figures; and if to the remainder another period of two cyphers had been brought down, the quotient figure would have been a cypher, and the addition of a period of two cyphers more would, to its reſpective diviſor, produce 8 for a quotient figure.

EXTRACTION of the CUBE ROOT.

TO extract the Cube Root, is to diſcover the root or firſt number, of which the number given to be extracted is the cube, or third power, produced by multiplying ſuch root or number by itſelf, and that product again by the ſame root; as 5 by 5, and the product of theſe again by 5; 9 by 9, and that product again by 9, &c.

Point the given number, whether whole numbers or decimal fractions, or both, into periods of three figures, always placing the firſt over the place of units in whole numbers (if any), but if none, over the third place, to the right hand of the decimal point, ſupplying the period with cyphers in the decimals, if wanted. Then conſider what ſingle figure, for which the table annexed will be uſeful, multiplied by itſelf, and the product again by ſuch figure, will make the number next leſs than the firſt period to the left hand, and place ſuch ſingle figure in the quotient or root, and its cube under the firſt period, ſubtracting it, and to the remainder bringing down the next period of three figures or cyphers for a dividend. Multiply the ſquare of the quotient or root already found by 300 for a diviſor, and try how often the diviſor can be had in the dividend (which muſt not be more than 9 times), and, having placed ſuch figure in the root, and drawn a line under the dividend, multiply the diviſor by it, ſetting down the product under ſuch line. Then ſquare the laſt quotient figure, and multiply it by the reſt of the figures in the root or quotient, and that by 30, which ſet down under the former product, and under both the cube of the laſt figure; ſubtract the ſum of theſe three numbers from the dividend, and to the remainder bring down a new period for a new dividend, and proceed for the diviſor, &c. as before.

Note, What I have obſerved of any product's being greater in extracting the ſquare root than the reſpective full dividend, and of leſſening the quotient figure by unity, ſo as to occaſion the remainder to exceed the diviſor, is more common here, and therefore ſhould not prevent the regular proceſs of the work. The following table will be of uſe to diſcover readily the firſt figure of the root, and for giving the firſt diviſor; for the diviſor differs here for every figure placed in the quotient or root.

Roots or 1ſt Power.	1	2	3	4	5	6	7	8	9
Cubes.	1	8	27	64	125	216	343	512	729
Firſt Diviſors.	300	1200	2700	4800	7500	10800	14700	19200	24300

Example 1. *What is the Cube Root of* 31855013?

```
          .  .  .
        31855013 (317 Answer.
        27    .  .
        ----
    2700)4855                31        7
        -----                31        7
        2700                ---      ---
          90                 31       49
           1                 93       31
        ----                ---      ---
        2791                961       49
        ---------           300      147
  288300)2064013           ----      ---
        -------          288300     1519
        2018100                       30
          45570                    -----
            343                    45570
        -------
        2064013
        -------
        .......
```

Example 2. *What is the Cube Root of* 17034106517?

```
        .  .  .  .
       17034106517(2573 Anſwer.
        8  .
        ----
   1200)9034           25      7
        ----           25      7
        6000          ---    ---
        1500          125     49
         125          50      25
        ----          ---    ---
        7625          625    245
      ---------       300    98
 187500)1409106     -----    ---
      ---------    187500   1225
        1312500               30
          36750          -------
            343            36750
      ---------          -------
        1349593
      -------------   257    3     257
 19814700)59513517    257    3       9
          --------    ---    -     ---
          59444100   1799    9    2313
             69390  1285            30
                27  514       ------
          --------  -----       69390
          59513517  66049     ------
          --------    300
          ........-------
                 19814700
                 --------
```

Note, That in the preceding operation the ſecond figure in the root is only 5, though the diviſor is contained 7 times in the dividend. But it is evident that the numbers to be added to it are large; and though the remainder conſiderably exceeds the diviſor, yet as the ſecond diviſor increaſes ſo much, the neceſſity is plain and obvious.

Example 3. *Required the Cube Root of* 810546.421?

```
          .  .  .
          810546.421(93.237 Anſwer.
          729  .  .
          ------        3           93         2
    24300)81546         3           93         2
          ------      ---          ---       ---
           72900        9          279         4
            2430        9          837        93
              27      ---          ---       ---
          ------       81         8649       372
           75357       30          300        30
          -------     ---      -------     -----
  2594700)6189421    2430      2594700     11160
          -------              -------     -----
          5189400                  932      3   932
            11160                  932      3     9
                8                  ---     --   ---
          -------                 1864      9  8388
          5200568                 2796           30
          ---------               8388        ------
260587200)988853000              ------       251640
          ---------              868624       ------
          781761600                 300
             251640           ---------
                 27           260587200
          ---------           ---------
          782013267                     9323   7  9323
          ------------                  9323   7    49
26075498700)206839733000               -----  --  ----
            ------------               27969  49 83907
            182528450900               18646     37292
                13704810               27969     -----
                     343               83907    456827
            ------------            --------        30
            182542156053            86918329  --------
            ------------                 300  13704810
             24297576947          -----------
                                  26075498700
                                  -----------
```

Note, That in this operation, to obtain the ſecond and third decimal places in the root, periods of cyphers are annexed to the remainders. In like manner the work might be continued without end, but three places are in general ſufficient.

The USE *of the* SQUARE ROOT.

IF the root of any ſquare number, or ſide of any ſquare ſuperfices, or diameter of any circle, be given, to find the root of any other ſquare number, ſide of a ſquare ſuperfices, or diameter of any circle, ſo as to bear any required proportion, multiply the ſquare of ſuch root, ſide, or diameter, by the number which ſhews that proportion, and the ſquare root of that product will be the root, ſide, or diameter required.

Example. Suppoſe the floor of a malt kiln to be 13.5 feet ſquare, what will be the ſide of a ſquare which ſhall contain three times the quantity, when laid of the ſame thickneſs or depth?

```
         13.5
         13.5
       --------
          675
         405
        135
       ---------
        182.25
             3 Ratio.
       ---------
        546.75(23.38 Anſwer.
        4
       ------
    43)146
       129
       ------
   463)1175
        1389
       ------
  4668)38600
       37344
       ------
       (1256)
```

Note, This may be applied to lay out ſquare or circular plots of ground in any proportion, or to the ſize of water pipes for filling ciſterns in houſes, &c.

The time of heavy bodies falling through the air by their own weight, may be found by knowing the height of the place from whence they fall: and, on the contrary, the height from the time. For as it has been found by experiment, that a heavy body near the earth's ſurface will fall $16\frac{1}{12}$ feet in the firſt ſecond of time, and that the fall is accelerated in proportion to the ſquare of the time in falling, it follows, that if the height be given to find the time, ſuch height muſt be divided by $16\frac{1}{12}$ feet (as taught by caſe 7, p. 227), and the ſquare root of the quotient extracted for the time in ſeconds. Or, if the time be given, multiply the ſquare of it in ſeconds by $16\frac{1}{12}$ feet, and the product will be the height in feet.

Example 1. In what time will a ſtone fall from the top of the ſpire of Saliſbury Cathedral, by its own weight, ſuppoſing it to be 410 feet high?

$16\frac{1}{12}$
12
193

410
12
193)4920(25.492227
386
1060
965
950
772
1780
1737
430
386
440
386
540
386
1540
1351
(189)

25.492227(5.048
25
1000)4922
4016
10088)90627
80704
9923

Anſw. 5.048 Seconds

Example 2. We read in the heathen mythology, that JUPITER, being enraged at VULCAN, threw him out of heaven, and that his fall to the iſland of *Lemnos*, where he was found, took up a whole ſummer's day. The longeſt day in that iſland is about 14 hours and 40 minutes, and if he fell at the rate of other heavy bodies, I would wiſh to know the height of this poetical heaven?

Anſwer, 8492000 miles.

It has been diſcovered by experience, that a pendulum of a clock at and near London, to vibrate ſeconds, or 60 times in a minute, muſt be 39.2 inches long; but as pendulums are frequently required of different lengths, it is known that theſe are reciprocally proportional to the ſquare of the number of their vibrations in a minute; and from hence we have this rule: As the length of a ſecond pendulum, is to the ſquare of the number of its vibrations in a minute, ſo is the propoſed length of another pendulum, to the ſquare of its number of vibrations, of which extract the ſquare root. If the number of vibrations are given, and the length required, reverſe the terms.

Example. If the length of a ſecond pendulum be 39.2 inches, what is the length of a pendulum which ſhall meaſure half ſeconds, or vibrate 120 times in a minute?

```
     Vibr.   Inch.      Vibr.
As    60  :  39.2   ::   120
      60     3600        120
    ----   -------     -----
    3600   235200      14400
            1176
         -----------
  144|00)1411|2.00(9.8 Inches, Anſwer.
         1296
         ----
         1152
         1152
         ----
         ....
```

For many other uſes of the ſquare root, I muſt refer to the examples in Trigonometry, Surveying, &c.

The USE of the CUBE ROOT.

IF the root of any cube number, or the ſide of any cubic or ſolid body, or meaſure of capacity, or diameter of any ſphere or globe, be given, to find the root of any other cube number, ſide of any ſolid body, or diameter of any ſphere or globe, ſo as to bear any required proportion, multiply the cube of ſuch root, ſide, or diameter, by the number which ſhews that proportion, and the cube root of that product will be the root, ſide, or diameter required.

Example 1. If a maltſter has a ciſtern, whoſe ſide is exactly 40 inches, and of a cubical form, and he wiſhes to have another to hold half as much more in quantity, and of a like form, what will be the ſide of it?

```
           40
           40
         -----
         1600
           40
        ------
        64000
          1.5
       -------
       320000
       64000
       -------
       96000.0(45.8 Inches nearly, Anſwer.
       64
       ----
  4800)32000
       -----
       24000
        3000
         225
       -----
       27125
       --------
607500)4875000
       --------
       4860000
         86400
           512
       -------
       494[illegible]912
```

Example 2. If a cannon ball of 4 inches diameter weigh 12 ℔. what will be the diameter of a ball of 24 ℔?

```
         ℔.     Inch.        ℔.
    As   12  :   4    : :    24
                 4
               ———
                16
                 4
               ———
                64
                24
               ———
               256
              128
             —————
          12)1536
             —————
              128(5.04
              125
            ——————————
     750000)3000000
            ——————————
             3000000
               24000
                  64
            ——————————
             3024064
            ——————————
```

Note, That in both theſe examples, the laſt figure of the root is a little too much, but differs ſo little from truth, as to be imperceptible when applied to uſe.

Hence it is, that the tonnage of ſhipping is computed in proportion to ſhips of larger or ſmaller dimenſions; for if you have the length of the keel of any ſhip, with her burden, the burden of any other ſhip built in like manner may be had, by having the length of her keel: or, the length of the keel may be determined by the propoſed burden; for as the cube of the keel of the given ſhip is to her burden, ſo is the cube of the keel propoſed, to her correſponding burden; and, by reverſing the terms, the length of the keel may be known from the burden.

Example 1. Suppoſe the burden of a ſhip of 80 feet in the keel to be 600 tons, what will be the burden of a veſſel, whoſe keel is but 40 feet?

```
       Feet    Tons.     Feet.

As      80  :   600  : :   40
        60                 40
     -----              -----
      6400               1600
        80                 40
     -----            -------
    512000              64000
                          600
          -------------------
      512 | 000)38400 | 000(75 Tons, Anſwer.
                3584·
                -----
                 2560
                 2560
                 ----
                 ····
```

Example 2. If a ſhip of 40 feet in the keel be 75 tons burden, what keel muſt that ſhip have, whoſe burden is 1000 tons?

```
  Tons.   Feet.      Tons.
As 75   :   40   ::   1000
            40
          ------
          1600
            40
          ------
         64000
          1000
        --------
75)64000000 ——— (853333·333333(94·85 Feet,
   600·····         729    ·    ·    ·  Anſw.
   ----            ------
    400      24300)124333
    375            ------
    ----            97200
     250             4320
     225               64
     ----          ------
      250          101584
      225          ---------
      ----  2650800)22749333
       250         ----------
       225          21206400
       ----           180480
        250              512
        225         ----------
        ----        21387392
         250 &c.    -----------
      269611200)1361941333
                    -----------
                    1348056000
                        711000
                           125
                    -----------
                    1348767125
                    -----------
                    (13174208)
```

Note, That the remainder in the diviſion being always 25, the quotient figure, of which the cube root is to be taken, will be always 3.

For ſome other examples, wherein the ſquare and cube roots are jointly exerciſed, relating to the laws of the heavenly bodies, ſhall be introduced in treating of Aſtronomy.

RULES of PRACTICE.

IT is uſual to give this name to certain ſhort and compendious ways of caſting up the value of merchandiſe, as being ſhorter than thoſe of Multiplication or Proportion, and is commonly performed by taking the aliquot, or even parts of a pound, ſhilling, &c. for the price of an integer. Thus 2*d*. is the ſixth part of a ſhilling, becauſe there are ſo many times 2*d*. in a ſhilling; 3*d*. is the fourth part, &c. The following tables will, if properly got by heart, with a few examples, make it eaſy.

TABLE I. *The Aliquot Parts of a Shilling.*

d.	*q.*			
1		is one	12th	of a Shilling.
1	2		8th	
2			6th	
3			4th	
4			3d	
6			half	

TABLE II. *The Aliquot Parts of a Pound.*

s.	*d.*			
	6	is one	40th	of a Pound.
	8		30th	
	10		24th	
1			20th	
1	8		12th	
2			10th	
2	6		8th	
3	4		6th	
4			5th	
5			4th	
6	8		3d	
10			half	

Example 1. *What will* 327 *yards of Cloth come to at* 4*s. per yard?*

s. *l.*
4 | $\frac{1}{5}$ | 327
65*l.* 8*s.* Anſw.

As 4s. is the 5th of a pound, therefore by taking the 5th part of 327, the given quantity, the quotient 65 will be the anſwer in pounds, and the two which remains will be ſo many times 4s. or 65l. 8s. the true anſwer.

Example 2. *What will* 519*lb. of any commodity coſt, at* 6*d. per lb.?*

d. *s.*
6 | $\frac{1}{2}$ | 519
2|0 | 25|9 6
12*l.* 19*s.* 6*d.* Anſw.

As 6d. is the half of a ſhilling, therefore by taking the half of 519, the given quantity, the quotient 259 will be the anſwer in ſhillings, and the one which remains will be equal to the given price, that is 6d. and reduce the ſaid quotient by 20 into pounds, becauſe 20 ſhillings are a pound, and then the anſwer is 12l. 19s. 6d.

Example 3. *What is the value of* 431 *yards of any article, at* 2*s.* 6*d. per yard?*

s. d.		
2 6	$\frac{1}{8}$	431
		53*l.* 17*s* 6*d.* Anſw.

Here 2*s.* 6*d.* is the 8th of a pound, by which the given quantity 431 is to be divided, and the quotient will be 53*l.* and as the 7 remaining is ſo many times 2*s.* 6d. therefore the anſwer is 53*l.* 17*s.* 6*d.*

In like manner all other queſtions may be reſolved, where the price is an aliquot part of a ſhilling or pound, whether conſiſting of pence or farthings only, or of pence and farthings; or again of ſhillings, or of ſhillings and pence. But when the given price is not the aliquot part of a ſhilling, take ſome aliquot part leſs; and for what is wanting, take the part or parts of that, till the ſeveral parts are equal to it; as in the following examples;

Example 4. *What is the value of* 537 *ells of Cambric, at* 5*s.* 4*d. per ell?*

s.	*l.*	
5	$\frac{1}{4}$	537
d.		
4	$\frac{1}{15}$	134 5
		8 19
		143*l.* 4*s.* Anſw.

In this example, 5*s.* is the 4th of a pound, and the remaining 4*d.* is the 15th part of 5*s.* ſo that, firſt, the 4th of 537 is 134*l.* 5*s.* and the 15th of that is 8*l.* 19*s.* which together make 143*l.* 4*s.* the value required; for as 4*d.* added to 5*s.* make the full price of one ell, ſo the value of the given quantity at 4*d.* or 8*l.* 19*s.* added to the value at 5*s.* or 134*l.* 5*s.* muſt give the whole value of the given quantity at the given price.

Example 5. *Required the value of* 509 *dozen of any article of merchandize, at* 3*s.* 7*d*½. *per dozen?*

s. d.	l.			
3 4	$\frac{1}{6}$	509		
2	$\frac{1}{25}$	84	16	8
1	½	4	4	10
½	½	2	2	5
		1	1	2½

92*l.* 5*s.* 1*d*½. Anſw.

In the firſt place, 3*s.* 4*d.* the aliquot part next leſs than the price is one ſixth, and 2*d.* is one 20th of that, and 1*d.* is half of that, and a halfpenny is one half of 1*d.* which ſums together juſt make up the price; and the ſum of the ſeveral quotients muſt in like manner be the true value of the given quantity, and the anſwer to the queſtion. And thus may the value of any quantity be readily found, at almoſt any other price, ſo that one obſervation more will be fully ſufficient for the common caſes of Practice; which is when the price is equal to any number of ſhillings.

If the price is any even number of ſhillings, or ſuch as can be divided by 2 without a remainder, then multiply the units of the given quantity by the whole price for ſhillings, and carry the pounds; then multiply the reſt of the quantity by half the price, adding to the product the pounds you carried forward. But if the price given is an odd number of ſhillings, multiply the quantity by ſuch price, and divide the product by 20 for the anſwer in pounds. And if the price conſiſt of pounds and ſhillings, the given quantity multiplied by ſuch price, and added to the value of the ſaid quantity, at ſo many ſhillings, will give the whole value at the price propoſed.

Example 6. *Required the value of* 713 *ſheep, at* 12*s. each?*

71	3
6	12

427*l.* 16*s.* Anſw.

Here I place the 3 in the place of units, by itſelf, to be multiplied by the given price, ſetting down the 16 ſhillings of the product, and carrying one pound; then multiply the reſt of the figures, or 71, by the half price, adding to the product the one pound carried, and the anſwer will be 427*l.* 16*s.* for the true value.

Example 7. *What is the value of 583lb. of Tobacco, at 3s. per lb?*

583
3
2|0)174|9
87*l.* 9*s.* Anſw.

In this operation, it is obvious that the given quantity is multiplied by the price, and the product divided by 20, which makes the anſwer 87*l.* 9*s.*

TARE and TRETT.

THIS branch it has been thought proper to annex to Practice, as having ſome degree of affinity therewith, the Tare being commonly found or deducted by means of taking the aliquot parts. But firſt I muſt premiſe, that Tare is the allowance made for the package of goods, at ſo much per bag, box, &c. or at ſo much per cwt. or at ſo much in the whole groſs weight, *i. e.* the full weight both of goods and package. Trett is alſo an allowance of 4℔. in every 104℔. for waſte, &c. Cloff is alſo an allowance of 2℔. for every 3 cwt. on ſome ſort of goods. Suttle is a term uſed, when any part of the allowances has been deducted, whether one or more, when any remain to be deducted; and Neat, is the pure weight after all deductions are made. To have by heart the following tables will be uſeful.

TABLE I. *The Aliquot Parts of a Ton.*

C.	*qr.*	*lb.*			
1			is one	20th	of a Ton.
2				10th	
2	2			8th	
2	3	12		7th	
4				5th	
5				4th	
10				half	

TABLE II. *The Aliquot Parts of an Cwt.*

lb.			
14	is one	8th	of an Cwt.
16		7th	
28		4th	
56		half	

TABLE III. *The Aliquot Parts of a Qr. Cwt.*

lb.			
$3\frac{1}{2}$	is one	8th	of a Qr. Cwt.
4		7th	
7		4th	
14		half	

Example 1. *Required the neat weight of 24 hogſheads of Sugar, each 7 cwt. 2 qr. 14lb. Tare, at 14lb. per cwt.?*

		Cwt.	qr.	lb.	
		7	2	14	
				6	
		45	3	0	
				4	
lb.					
14	$\frac{1}{8}$	183	0	0	Groſs.
		22	3	14	Tare.
	Cwt.	160	0	14	Anſwer.

Example 2. *What is the neat weight of 5 hogſheads weighing together 44 cwt. 3 qr. 14lb. groſs, Tare in al 142lb. and Trett 4lb. in every 104lb.?*

	Cwt.	qr.	lb.	
	44	3	14	Groſs.
	1	1	2	Tare.
26	43	2	12	
	1	2	19	Trett.
Cwt.	41	3	21	Anſwer.

Theſe examples will ſuffice to ſhew the nature and importance of this rule, and the expediency of paying attention to it. Loſs and Gain, Barter, Exchange, &c. may be paſſed over, becauſe all of them may be done either by the Rule of Three, or the Rules of Practice already explained.

Of DUODECIMALS, with their Uſes.

THE foundation of Duodecimals is, that as the foot is divided into 12 inches, ſo the inch is divided into 12 parts, called ſeconds, and that again is ſuppoſed to be divided into 12 other parts, called thirds, and ſo on without end.

Examples of Addition.

Feet.	*In.*	″	‴
17	6	7	9
25	8	6	4
38	9	4	2
6	4	9	3
19	11	5	8
26	5	4	7
11	4	8	6
146	2	10	3

Feet.	*In.*	″	‴	⁗
137	5	8	2	5
84	3	5	7	6
23	0	7	6	2
205	4	6	3	4
47	7	4	2	8
26	3	0	8	0
61	6	2	4	9
585	6	10	10	10

Note, That in the former example you begin with thirds, marked with three daſhes, and in the ſecond with fourths, having four marks, and in each carry one for every 12.

Examples of Subtraction.

	Feet.	*In.*	″	‴
From	73	5	8	1
Take	27	6	9	5
Remains	45	10	10	8

Feet.	*In.*	″	‴	⁗
321	3	2	8	3
176	5	7	11	6
144	9	6	8	9

Examples of Multiplication.

	Feet.	In.		Feet.	In.	
Multiply	9	7		11	5	
by	5	6		4	7	
	47	11	″	45	8	″
	4	9	6	6	7	11
Anſw.	52	8	6	52	3	11

Note, That in the former example, the 7 inches are firſt multiplied by the 5 feet, which making 35, I ſet down 11 inches, and carry 2 feet, which added to the product of the feet, will make 47 feet; then multiply the 7 inches by the 6 inches, and the product will be 42 ſeconds (for inches multiplied by inches give ſeconds), where I ſet down 6 ſeconds, one place removed to the right hand, as above, and carry 3 inches; and having multiplied the 9 feet by the 6 inches, with the 3 inches added, will make 57 inches, or 4 feet 9 inches; and, laſtly, add the two lines together for the product. And in like manner all others, conſiſting of feet and inches only, if the feet in the multiplier are not more than 12, are performed.

If either the multiplier or multiplicand, or both, have ſeconds, the ſame rule will do for the ſeconds, only obſerving, that ſeconds by ſeconds give fourths, and inches by ſeconds give thirds, &c. In like manner for any number of denominations, only increaſing one line for each additional denomination of the multiplier.

	Feet.	In.		Feet.	In.	
Multiply	57	7		33	5	
by	23	9		19	8	
	171			297		
	114			33		
	13	5	″	7	11	″
	43	2	3	22	3	4
Anſw.	1367	7	3	657	2	4

Note, In the firſt preceding example, the feet being more than 12, the feet in the multiplicand are multiplied by the feet in the multiplier, which form the two firſt lines of the product, and then the inches of the multiplicand by the feet in the multiplier, which makes the third line. Again the multiplicand is multiplied by the inches of the multiplier, and the product in feet, inches, and ſeconds, is ſet down in the fourth line, and the ſum of the four lines will be the product. Thus all other examples of this nature are done, whether they conſiſt of two, three, or more denominations, increaſing one line for each additional denomination in the multiplier.

The Application to ARTIFICERS WORK.

Example 1. A glazier, having finiſhed the lights of a gentleman's villa, finds his account to ſtand as follows: The firſt range of windows meaſured 137 feet, 9 inches, 9 ſeconds; the ſecond meaſured 111 feet, 4 inches, 6 ſeconds, 7 thirds; and the upper ſtory 87 feet, 3 inches, 3 ſeconds, on the ſouth ſide; on another ſide of the firſt range was 99 feet, 6 inches, 6 ſeconds; the ſecond was 75 feet, 4 inches, 8 ſeconds, 5 thirds, 3 fourths; and the upper range, or attic ſtory, was 51 feet, 5 inches, 9 ſeconds; the lights of ſtair caſes, and other irregular windows, amounted to 137 feet, 3 inches. How many feet did the whole contain?
Anſw. 700 feet, 1 inch, 6 ſeconds, 0 thirds, 3 fourths.

Note, That theſe quantities are ſuppoſed ſeverally to be found by Multiplication of Duodecimals, as already ſhewn, and will further appear in theſe examples.

Example 2. A maſon meaſured ſeveral pieces of paving done by his workmen, of which the firſt was 67 yards, 5 feet, 3 inches, 9 ſeconds; the next was 57 yards, 6 feet, 7 inches; the third meaſured 39 yards, 8 feet, 6 inches, 10 ſeconds; the fourth contained 106 yards, 2 feet, 6 inches, 3 ſeconds; and a fifth was 76 yards, 4 feet.

How many yards did theſe five pieces of workmanſhip contain? Anſw. 347 yards, 8 feet, 11 inches, 10 ſeconds.

Note, That in paviours, and all other work done by the yard ſquare, 9 feet are equal to one yard.

Example 3. A carpenter laid ſeveral floors in a gentleman's new villa, which meaſured as follows: the firſt was 1 ſquare, 3 quarters, 17 feet, 6 inches; the ſecond contained 1 ſquare, 1 quarter, 11 feet, 7 inches, 4 ſeconds; a third contained 2 ſquares, 0 quarters, 15 feet, 3 inches; and a fourth was 1 ſquare, 2 quarters, 3 feet, 0 inches, 5 ſeconds. How much was the whole? Anſw. 6 ſquares, 3 quarters, 22 feet, 4 inches, 9 ſeconds.

Note, That in flooring, partitioning, and works which are meaſured by the ſquare, 25 feet are equal to one quarter, and 4 quarters to a ſquare, or 100 feet are equal to one ſquare. All theſe are done by addition only.

Example 4. A joiner having finiſhed ſome rooms very curiouſly, in order to eſtimate the charge, ſums up the whole to be 573 feet, 6 inches, 2 ſeconds, 3 thirds, out of which he is to make ſeveral deductions for doors, windows, &c. as ſeperate workmanſhip, amounting to 76 feet, 9 inches, 5 ſeconds, 7 thirds, 3 fourths. How many feet muſt he charge for? Anſw. 496 feet, 8 inches, 8 ſeconds, 7 thirds, 9 fourths.

Note, That this and the two following are done by Subtraction.

Example 5. A carpenter having purchaſed ſeveral parcels of boards, amounting to 401 feet, 1 inch, wrought up the quantity of 167 feet, 5 inches, 6 ſeconds. How many feet remained? Anſw. 233 feet, 7 inches, 6 ſeconds.

Example 6. The area of a gentleman's court was 226 yards, 5 feet, 7 inches, which was to be laid with aſhlar, in ſuch a manner, as to leave a ſquare in the middle, containing 89 yards, 7 feet, 9 inches, 8 ſeconds. What quantity was to be laid down? Anſw. 136 yards. 6 feet, 9 inches, 4 ſeconds.

Example 7, The chancel of a church was to be paved with marble, whoſe length was 30 feet, 6 inches, 3 ſeconds, and the breadth 18 feet, 4 inches, 6 ſeconds. How many ſquare feet did it contain? Anſw. 560 feet, 9 inches, 10 ſeconds, 1 third, 6 fourths.

Note, That maſons very often meaſure their work by ſquare feet, in laying aſhlar, marble, &c. Glaziers alſo meaſure by the foot ſquare. This and the following queſtion are performed by Multiplication only.

Example 8. The windows of a gentleman's houſe were to be new glazed, and their ſize was as follows: Five were 5 feet 6 inches high, by 3 feet, 4 inches, 3 ſeconds broad; four more were 4 feet, 9 inches, 6 ſeconds high, by 2 feet 9 inches broad; and three more were 3 feet, 8 inches, 3 ſeconds in height, by 7 feet, 3 inches, and 6 ſeconds in length. How many feet of glazing did the whole contain? Anſw. 225 feet, 7 inches, 4 ſeconds, 1 third, 6 fourths.

Example 9. A room was to be plaiſtered, the two end walls of which were 13 feet 3 inches broad, and the height of the room was eight feet 3 inches. How many yards of plaiſtering muſt be charged, ſuppoſing the length of the room to have been 16 feet 6 inches? Anſw. 54 yards, 4 feet, 10 inches, 6 ſeconds.

Note, That the beſt way of computing by ſquare yards is, firſt to compute by feet, and to divide the product in feet by 9 for the ſquare yards.

Example 10. If a floor be 67 feet 6 inches in length, and 30 feet 3 inches in breadth, how many ſquares of 100 feet each does it contain? Anſw. 20 ſquares, 1 quarter, 16 feet, 10 inches, 6 ſeconds.

Note, That the beſt way is to compute by feet, and to cut off two figures to the right hand for the ſquares; and if the figures cut off exceed 25, divide by that for the quarters, and the remainder will be feet, as in this and the two following examples.

Example 11. Suppoſing the area, or floor of Weſtminſter-Hall, allowed to be the largeſt room in Europe, or perhaps in the world, to be 220 feet 3 inches in length, and 69 feet 9 inches in breadth; how many ſquares are contained in the ſaid floor? Anſw. 153 ſquares, 2 quarters, 12 feet, 5 inches. 3 ſeconds.

Example 12. A bricklayer, after roofing a houſe, meaſures the depth to be 14 feet 6 inches on the one ſide, and 16 feet 9 inches on the other, and the length of the houſe was 34 feet 7 inches: how many ſquares does the whole contain? Anſw. 10 ſquares, 3 quarters, 5 feet, 8 inches, 9 ſeconds.

Example 13. A wall of 257 feet 6 inches in length, and 5 feet 9 inches in height, was to be built of a ſtandard thickneſs, which is a brick and a half; how many rod will the ſame contain? Anſw. 5 rods, 1 quarter, 52 feet, 7 inches, 6 ſeconds.

Note, That the rod of brick work is 272 feet and a quarter; but it is cuſtomary to divide the feet by 272 feet (dropping the quarter), and the remainder, divided by 68, will give the quarters, leaving the reſidue for the feet. By this method are this and the following example performed, except as there noted.

Example 14. Suppoſe the ſame wall was to be built one half at two bricks thick, and the other at ſtandard, or a brick and a half thick; how many rod muſt be charged for the ſame? Anſw. 6 rods, 1 quarter, 27 feet, 4 inches, 9 ſeconds.

Note, That half the height of the wall muſt here be the multiplier to the given length, and the value of the product found as before: but for the other half at 2 bricks thick, one third muſt be added to the product, and that ſum divided by 272 and 68 as before, both which will be the whole meaſure.

Example 15. The lower ſtory of a chimney meaſures thus: the breaſt wall and the depth of the two ſides are together 18 feet 9 inches, and the height of it is 12 feet 6 inches. The ſecond ſtory in like manner meaſures 14 feet 6 inches, by 9 feet; the third 10 feet 3 inches, by 7 feet, and the compaſs of the chimney above the roof is 13 feet 9 inches, by 6 feet 6 inches. The depth of the middle fetter, which parts the funnels, is 12 feet, and its width 1 foot 3 inches, and the whole is to be meaſured as double meaſure; how many rods of 272 feet muſt be charged? Anſw. 3 rods, 3 quarters, 62 feet.

Note, That the above example comprehends every thing neceſſary to be known with reſpect to the meaſuring chimney work, and is adopted from an approved author for that purpoſe.

Example 16. A maſon built a wall of 35 feet 6 inches in length, and 19 feet 9 inches in height; how many rod of 63 feet did the ſame contain? Anſw. 11 rods, 8 feet, 1 inch, 6 ſeconds.

Note, That this example is done by feet, and divided by 63 feet, it being cuſtomary in ſome places to reckon 63 feet ſuperficial to the rod, let the thickneſs be what it may, eſpecially where buildings are of ſtone.

Example 17. If a ſtone be 7 feet 6 inches in length, 4 feet 9 inches in breadth, and 3 feet 3 inches in depth; how many ſolid feet does it contain? Anſw. 115 feet, 9 inches, 4 ſeconds, 6 thirds.

Note, That in this and the two following examples, two of the dimenſions are firſt multiplied together, and that product by the third, and then the feet contained in the laſt product are divided by 27, the number of ſolid feet in a ſolid yard.

Example 18. A piece of timber was put into a building 19 feet 3 inches long, 1 foot 3 inches broad, and twelve inches thick; how many feet of timber were contained in that piece? Anſw. 24 feet, 0 inches, 9 ſeconds.

Example 19. A cellar of 26 feet 3 inches in length, 15 feet 3 inches in breadth, and 7 feet 6 inches in depth, was to be dug; how many ſolid yards of earth would be removed? Anſw. 111 yards, 5 feet, 4 inches, 1 ſecond, 6 thirds.

GENERAL OBSERVATIONS, *uſeful and neceſſary to be known by* Artificers *and their* Employers.

MASONS very frequently meaſure their work by ſquare feet, or 12 inches in length by 12 inches in breadth; as in laying aſhlar, marble, &c. Aſhlar is laid as it is cut out of the quarries, ſo that the thickneſs is not meaſured; and marble is laid by the ſquare foot, but valued by the ſolid foot.

Glaziers in like manner meaſure by the ſquare foot, and uſually take their dimenſions to a quarter of an inch, or three ſeconds. They make no allowances for half rounds, or for oval windows, but meaſure them as if they were perfectly ſquare, on account of the great trouble in preparing them, and the waſte of glaſs in cutting them.

Carpenters, and ſome other workmen, alſo meaſure their boards, &c. by the foot ſquare; but carpenters ſometimes compute by the ſquare of 100 feet.

Paviours, whether they uſe bricks, tiles, pebbles, &c. uſually meaſure their work by the yard ſquare; and

Note, That half the height of the wall muſt here be the multiplier to the given length, and the value of the product found as before: but for the other half at 2 bricks thick, one third muſt be added to the product, and that ſum divided by 272 and 68 as before, both which will be the whole meaſure.

Example 15. The lower ſtory of a chimney meaſures thus: the breaſt wall and the depth of the two ſides are together 18 feet 9 inches, and the height of it is 12 feet 6 inches. The ſecond ſtory in like manner meaſures 14 feet 6 inches, by 9 feet; the third 10 feet 3 inches, by 7 feet, and the compaſs of the chimney above the roof is 13 feet 9 inches, by 6 feet 6 inches. The depth of the middle fetter, which parts the funnels, is 12 feet, and its width 1 foot 3 inches, and the whole is to be meaſured as double meaſure; how many rods of 272 feet muſt be charged? Anſw. 3 rods, 3 quarters, 62 feet.

Note, That the above example comprehends every thing neceſſary to be known with reſpect to the meaſuring chimney work, and is adopted from an approved author for that purpoſe.

Example 16. A maſon built a wall of 35 feet 6 inches in length, and 19 feet 9 inches in height; how many rod of 63 feet did the ſame contain? Anſw. 11 rods, 8 feet, 1 inch, 6 ſeconds.

Note, That this example is done by feet, and divided by 63 feet, it being cuſtomary in ſome places to reckon 63 feet ſuperficial to the rod, let the thickneſs be what it may, eſpecially where buildings are of ſtone.

Example 17. If a ſtone be 7 feet 6 inches in length, 4 feet 9 inches in breadth, and 3 feet 3 inches in depth; how many ſolid feet does it contain? Anſw. 115 feet, 9 inches, 4 ſeconds, 6 thirds.

Note, That in this and the two following examples, two of the dimenſions are firſt multiplied together, and that product by the third, and then the feet contained in the laſt product are divided by 27, the number of ſolid feet in a ſolid yard.

Example 18. A piece of timber was put into a building 19 feet 3 inches long, 1 foot 3 inches broad, and twelve inches thick; how many feet of timber were contained in that piece? Anſw. 24 feet, 0 inches, 9 ſeconds.

Example 19. A cellar of 26 feet 3 inches in length, 15 feet 3 inches in breadth, and 7 feet 6 inches in depth, was to be dug; how many ſolid yards of earth would be removed? Anſw. 111 yards, 5 feet, 4 inches, 1 ſecond, 6 thirds.

GENERAL OBSERVATIONS, *uſeful and neceſſary to be known by* Artificers *and their* Employers.

MASONS very frequently meaſure their work by ſquare feet, or 12 inches in length by 12 inches in breadth; as in laying aſhlar, marble, &c. Aſhlar is laid as it is cut out of the quarries, ſo that the thickneſs is not meaſured; and marble is laid by the ſquare foot, but valued by the ſolid foot.

Glaziers in like manner meaſure by the ſquare foot, and uſually take their dimenſions to a quarter of an inch, or three ſeconds. They make no allowances for half rounds, or for oval windows, but meaſure them as if they were perfectly ſquare, on account of the great trouble in preparing them, and the waſte of glaſs in cutting them.

Carpenters, and ſome other workmen, alſo meaſure their boards, &c. by the foot ſquare; but carpenters ſometimes compute by the ſquare of 100 feet.

Paviours, whether they uſe bricks, tiles, pebbles, &c. uſually meaſure their work by the yard ſquare;

and it is obſervable, that 32 bricks of the ſtatute ſize will juſt cover a yard, each brick being 9 inches long, and 4 inches and a half broad.

Plaiſterers alſo meaſure by the yard ſquare, which is uſually done either upon lath, and then it is called cieling work; or upon brick walls in partitions, called rendering. They make ſeveral allowances, and deduct for all chimney pieces, &c. in cieling, and for all doors, windows, &c. in partitioning: upon brick work in rendering, they allow nothing for doors or windows, unleſs by cuſtom of particular places, or by agreement. Between quarters, they often allow a fifth part, and ſometimes a fourth, if the workman finds ſtuff, but not elſe. Floors, &c. laid with lime or ſand, in imitation of ſtone work, are alſo meaſured thus.

Joiners make allowances for window lights, or are meaſured by the piece, or running meaſures; but if work is done on both ſides, they charge for work and half work. Window boards, ſkirt boards, &c. are meaſured by themſelves; as are chimney pieces, and other ornamental works, and are commonly valued by running meaſure. In taking the height of rooms, meaſure every turn of the moulding or cornice, and round the flat part of the room for the compaſs.

Painters take dimenſions as joiners do, and compute their work as once, twice, or thrice coloured; the firſt of which is called priming. Window lights, caſements, and ſometimes modillions, with their ornaments, are done at ſo much a piece. They meaſure by the yard ſquare, as joiners and plaiſterers.

Tylers, and perſons employed in covering roofs of houſes or buildings, whether with tiles, ſlate, thatch, &c. commonly compute by the ſquare of 100 feet; and not only meaſure to the extent in taking dimenſions, but uſually add 18 or 20 inches for the projection over the plate.

In flooring, it is common to deduct for all well holes, for ſtair caſes, chimney ways, &c. and in partitioning, for doors, door-caſes, and windows; but allowances are ſeldom made for chimney ſhafts, ſkylights, &c. in roofing, on account of the trouble.

Bricklayers vary much in computing their work. In ſome places they meaſure by the rod of 18 feet ſquare, or 324; in others by the rod of 16 feet ſquare, or 256; and ſometimes by the rod of 21 feet long, and 3 feet high, or 63 ſquare feet, the thickneſs being according to cuſtom; but the laſt is generally uſed by ſtone maſons. In meaſuring chimney work, if they ſtand alone, girt them about for the length, and take the height for the breadth; but where they ſtand againſt a wall which has been meaſured before, the depth of the two ſides, with the breaſt, muſt be taken for the length, and the height of the ſtory for the breadth.*

Before we proceed to Geometry, and the dependent branches, it may be proper here to preſent the ſtudent with the nature of board and timber meaſure, as of great uſe to artificers; particularly carpenters, joiners, and others converſant in timber, as well as gentlemen.

Of Board Measure.

In taking the meaſure of boards, the thickneſs is not regarded, though the value of them differs according to the thickneſs. It is uſual to take the length along the middle between the two edges, and the breadth in the middle between the two ends; and to find the content, take the following rule:

If the dimenſions were taken in feet and inches, or the length in feet and inches, and the breadth in inches, multiply the length by the breadth, as ſhewn in Multiplication of Duodecimals, and the product will be the anſwer in feet, and parts of a foot. Or if both were taken in inches, if the products, as they ariſe, are turned into the ſuperior denominations, the content will be had as before. In like manner a ſtock of boards, of the ſame length and breadth, may be meaſured, by multiplying the content of one board by the number of boards. Or if the length of the boards be equal, but the breadths different, take the different breadths with a ſtring in one dimenſion, and multiply that by the length of one board.

---

* For thoſe who deſire to be more fully acquainted with the Nature of any of theſe ſeveral Kinds of Meaſure, the Young Meaſurer's Complete Guide, by the late D. Fenning, may with the greateſt juſtice be recommended.

Example 1. If a board be 10 feet 6 inches long, and 1 foot 3 inches broad, how many ſquare feet does it contain?

	Feet.	*In.*		
	10	6		
	1	3		
	10	6		
	2	7	6	
Feet	13	1	6	Anſwer.

Example 2. In 14 boards, each 11 feet 8 inches long, and the middle breadth 11 inches 6 ſeconds; how many flat or ſquare feet?

	Feet.	*In.*			
	11	8			
		11	6		
	10	8	4		
		5	10	0	
Feet	11	2	2	0	in one Board.
			7		
	78	3	2		
			2		
Feet	156	6	4		in the whole, Anſwer.

Example 3. If the length of a parcel of boards be 9 feet 7 inches, and the ſum of their breadths, taken together, be 67 feet 6 inches; how many ſquare feet do they contain?

	Feet.	*In.*		
	67	6		
	9	7		
	607	6		
	39	4	6	
Feet	646	10	6	Anſwer.

But if a board is irregular in its breadth, meaſure it acroſs in the broadeſt and narroweſt places, which add together, and divide it by the number of breadths taken; and the quotient multiplied by the length gives the content.

Example 4. A board, whoſe length is 13 feet 9 inches is in breadth as follows: in one place 10 inches 6 ſeconds, in another 11 inches 3 ſeconds, in a third 10 inches 9 ſeconds, in a fourth 12 inches 6 ſeconds, and in a fifth 12 inches 3 ſeconds; how many ſquare feet does it contain?

	In.	*Sec.*	
	10	6	
	11	3	
	10	9	
	12	6	
	12	3	
5)	57	3	
	11	5	5 nearly.

	Feet.	*In.*	″	‴		
	13	9				
		11	5	5		
	12	7	3			
		5	8	9	⁗	
			5	8	9	
Feet	13	1	5	5	9	Anſwer.

Of Timber Meaſure.

As there are various ſorts and ſhapes of timber, there muſt neceſſarily be various methods of meaſuring it, and finding its content. The moſt uſual ways of doing this are here given.

It is common amongſt workmen and meaſurers, and dealers in timber, to gird a tree round the middle with a cord, and take the 4th part of the compaſs for the ſide of a ſquare of equal area. This is generally taken in inches, and the ſquare of that 4th being multiplied by the length in feet, and the product divided by 144, the content in ſolid feet will be obtained. The purchaſer is commonly allowed to gird the tree where he pleaſes, between the greater end and the middle of the tree.

Example. If the compaſs of a tree near the middle be 57 inches, and the length 38 feet 6 inches; what is the content in feet?

4(57

14.25
14.25

7125
2850
5700
1425

203.0625
38.5

10153125
16245000
6091875

144)7817.90625(54.291 Feet, Anſwer.
720

617
576

419
288

1310
1296

146
144

Note, That a crooked tree muſt not be meaſured on either the hollow or round ſide of the curve, but on the ſtraight ſide, bending the ſtring to the ſhape of the timber.

But if a tree is very unequally thick or taper, gird it in as many places as may be thought neceſſary, and divide their ſum by the number of the girths taken, for the mean girth or compaſs; and if the fourth part in inches be ſquared, and multiplied by the length in feet, and divided by 144 as before, the content, according to the cuſtomary method, will be obtained.

Example. If a tapering tree is 63 inches round in one place, 57 in another, 52 in another, and 45 in a fourth, nearly at equal diſtances from each other, and the length 29 feet; what is the content?

```
          63
          57
          52
          45
         ---
       4)217
         ----
       4) 54·25
         -----
         13.56
         13.56
         -----
          8136
         6780
        4068
       1356
      --------
      183.8736
            29
      --------
      16548624
      3677472
      --------
  144)5332·3344(37·03 Feet, Anſwer.
      432
      ---
      1012
      1008
      ----
        433
        432
        ---
          1
```

Note, That in all tapering timber, if it gradually diminiſhes in thickneſs, the diſtances of the compaſs meaſured ſhould be equal, and not too near each end.

And if a tree is large, ſo as to have branches of 24 inches and more in compaſs, ſo much of the ſaid branches as meaſure 24 inches, or upwards, muſt be conſidered as timber; but the trunk of a tree, if it does not meaſure 24 inches in compaſs, muſt not be conſidered as timber, beyond the place where it meaſures ſo much.

Example

Exnmple. A tree of 32 feet long has, for its mean compaſs, 100 inches, with two branches, one of 13 feet long, and 28 inches compaſs, and another of 11 feet long, and 24 inches compaſs; what is the content?

4)100	4)28	4)24
25	7	6
25	7	6
125	49	36
50	13	11
625	147	396
32	49	
1250	637	
1875		

20000
637 } Add
396

144)21033(146.06 Feet, Anſwer.
144..
663
576
873
864
900
864
36

The common way of girding round a tree, and taking the 4th part, does not give the full content of ſuch tree, but only in proportion of about 4 to 5, or more nearly of 11 to 14. But though the error is known, the practice is continued, and with very good reaſon; for as ſuch timber, till it is hewn, cannot be converted to any uſeful purpoſes, unleſs for pumps, pipes to convey water, or the like, it would be hard to charge for that which is unprofitable in general; and hence we have the beſt ground for continuing the cuſtom. As this mode of meaſuring will give the content of the ſame timber when it is hewed for uſe, the only diſadvantage to the buyer is that of carriage, and labour of hewing; but where the diſtance is great, is a matter of attention, it being ſettled by workmen and meaſurers, agreeable to the above proportion, that 40 feet of rough and unhewn timber ſhall be deemed a load, ſuppoſed to weigh a ton, or 20 cwt. but that 50 feet of hewn timber ſhall only be a load.

But perhaps the young ſtudent may be deſirous of knowing the method for finding the full quantity of ſolid feet in any round tree or piece of timber, and therefore the following rule and example will be a neceſſary illuſtration.

Rule.] As all round timber muſt be tapering, multiply the girth at one end by the girth at the other; then ſubtract the circumference at the leſſer end from the greater, ſquare the difference, and divide it by 3, which add to the former. Multiply the ſum by the decimal .0795, and the product by the length in feet, which divide by 144, and the quotient will be ſolid feet.

Example. A piece of timber is 136 inches in circumference at one end, and 32 at the other, the length being 21 feet; how many feet of timber does it contain?

```
             136                 136
              32                  32
            ----                ----
             272                 104
            408                  104
            ----                ----
Add { 4352                       416
    { 3605.33                   1040
      -------                 ------
       7957.33              3)10816
         .0795              -------
      -------                3605.33
      3978665
     7161597
    5570131
    ----------
    632.607735
            21
   -----------
    632607735
   1265215470
   -----------
144)13284.762435(92.255 Feet, Anſwer.
    1296...
    ----
     324
     288
     ---
      367
      288
      ---
       796
       720
       ---
        762
        720
        ---
         42
        ---
```

In like manner, we ſhall preſent the ſtudent with a rule for finding the content of a tapering ſquare piece of timber, with an example to illuſtrate it.

Rule.] If the breadth and depth are equal at the reſpective ends, multiply the ſquare of ſuch breadth or depth, in inches, at one end, by the ſquare at the other end, and extract the ſquare root of ſuch product; then add this root to the ſaid ſquares, and multiply the ſum by one third of the length in feet, dividing the product by 144, and the content will be had. Or if the breadth and depth are unequal, it is only to multiply the breadth by the depth, inſtead of ſquaring one of them, and proceed as before.

Example. A piece of timber is 32 inches broad, and 20 inches deep at one end, and 10 inches broad, and 6 inches deep at the other, and 18 feet in length; what is the content of that piece in ſolid feet?

```
       32                  640  ⎫
       20                   60  ⎬Add
      ----              195·95  ⎭
      640               ------
       60               895·95
     -----                   6
    38400(195·95        ------
     1 . .          144)5375·70(37·33 Feet, Anſw.
    ---                 432. . .
29)284                  ---
   261                  1055
   ---                  1008
385)2300                ----
    1925                 477
    ----                 432
3909)37500               ---
     35181               450
     -----               432
39185)231900             ---
      195925              18
      ------             ---
       35975
       -----
```

But there is one thing more, which thoſe who meaſure timber ſhould not overlook, and that is, in making allowance for trees growing, or newly cut down, which have their bark on. For oak trees, it is uſual to ſubtract one tenth, or one twelfth of the girth or circumference; but not ſo much for aſh, elm, beach, &c. When this ſubtraction or allowance is made, then find the content with the reſt, as before. Examples will be needleſs.

It has often been propoſed as a puzzling queſtion to ſcholars, how they will proceed to find the ſolid content of a faggot of bruſh-wood, furze, or the like; though that is of itſelf entirely uſeleſs, the method is of great uſe, and was ſucceſsfully practiſed by *Archimedes*, in the matter of the crown which had been made for King HIERO, which is this: immerſe the faggot, &c. in a regular veſſel full of water, and the quantity which runs over will be equal to the content in inches, which divide by 1728, will give ſolid feet. Or, by putting the faggot, &c. in a regular empty veſſel, whoſe content is or may be eaſily known, fill it up with water, and if the faggot is then taken out, and the empty part of the veſſel is meaſured, the content may be alſo known.

Of CHRONOLOGY, *and its Uſes.*

CHRONOLOGY is of the utmoſt utility in a courſe of education, but particularly in the ſtudy of hiſtory. Nothing within the compaſs of our own knowledge can be diſtinguiſhed into its proper period of time, and much leſs any thing which relates to paſt ages, without at leaſt a practical knowledge of this branch of ſcience. In every age and country, the neceſſity of ſome mode of adjuſting the particular occurrences of the times has been acknowledged; but in different nations, and amongſt different people, different ſchemes have been invented or adopted; and ſometimes, from remarkable circumſtances, theſe ſchemes have been changed or altered, as occaſions offered,

fered, in the ſame countries. We uſually diſtinguiſh the times from which theſe ſchemes are dated, or begin, by the name of æra, or epocha.

To mention a few of the moſt common epochas in their order, the firſt is the Julian period. This is an imaginary point of time, inſtituted in the time of the dictator Julius Cæſar, and commences 706 years before the creation of the world: it is moſt uſeful, as including nearly all others. In this imaginary year, the cycle of indiction, the moon's metonic cycle, and the ſun's cycle began together.

But though the Julian period goes ſo far back, the epocha of the creation is moſt ancient, and commences 4004 years before the birth of Chriſt, according to the beſt authorities; but the Greeks and eaſtern emperors, though with very little foundation, make the world of more ancient date. This was uſed by the Jews, who ſometimes alſo reckoned from the flood, which was 2338 years before our Saviour.

The moſt ancient epocha among prophane authors is that of the olympiads, each containing 4 years; they began in the ſummer of 777 before the birth of our Saviour. Soon after this, viz. in 753, according to the Varronian account, or 752 by Capitolian, the city of Rome was built, which became another epocha, or date of computation, and was only 24 or 25 years after the commencement of the olympiads. Again, the æra of Nabonaſſar, famous among aſtronomers, commenced in 747 before Chriſt, which was but 30 years later than the olympiads; but theſe years conſiſted only of 365 days each. Again, at the diſtance of 424 years from the preceding, or 324 years before our Saviour, was the death of *Alexander* the Great, which has been accounted by aſtronomers as an epocha.

But the moſt remarkable epocha among Chriſtians, is that which commences from the reputed time of our Saviour's birth, which differs a little from the true time. All the others are generally reduced to this by hiſtorians and chronologers, to preſerve order and uniformity. Others, as the *Abiſſines*, accounted from the time of the *Diocleſian* perſecution, 284 years after Chriſt's birth, called the æra of the martyrs.

Another remarkable epocha, uſed by the Turks, Arabs, and others profeſſing themſelves to be the followers of *Mahomed*, is the *Hegira*, or Flight of *Mahomed*, which was in the year of Chriſt 622; but the Perſians have an epocha 10 years later, in 632, which they call *Jeſdegird*, the laſt Perſian king of that name being then killed by the Saracens.

Our limits will not admit us to give a hiſtory of the different kinds of years, uſed as meaſures of computation in different ages of the world, by thoſe who have reckoned by the epochas already mentioned. Theſe were firſt gueſſed at by the motion of the ſun and moon, and variouſly altered, as obſervation and experience ſeemed to require. *Julius Cæſar* was the firſt who brought the year to ſome degree of exactneſs, by inſtituting a ſolar year of 365 days and 6 hours; but it is probable that he learned this from the *Egyptians*, and thence rectified the Roman calendar, which before had been much corrupted. This account of time was obſerved by moſt nations, from that time, till the year 1582, when the Gregorian ſtile commenced: for as it had been found, by repeated obſervation, that the proper length of the year was 11 minutes 5 ſeconds leſs than the Julian year, and that the vernal equinox (when the days and nights are equal) had got back to March 11th, inſtead of the 21ſt, as obſerved at the Council of *Nice* in 325, the calendar was accordingly rectified, and meaſures taken to prevent any conſiderable errors in future. This was not adopted by the Engliſh till 1752, being 170 years after.

The Turks and Arabs were almoſt the only people who did not approve of the Julian calendar; they ſtill perſevere in the ancient way of computing by moons, notwithſtanding the great reformation effected in other nations, to as great a degree of exactneſs as the nature of the thing will admit.

To return then to the Roman or Julian calendar, which we have adopted, it is of no importance to enquire why one month is longer than another, as the whole number of days in a year is commonly 365, but in every 4th year a day is added for the 6 hours in each year, which day is added to the ſhort month of February. —See the Diſtich given at page 107, with the Diviſions of Time mentioned in the preceding page.

If you want to find whether any particular year is a Leap-Year, or a common one, note this verſe,

Divide by 4, what's left ſhall be
For Leap-year 0, for paſt 1, 2, or 3.

Example 1. I deſire to know if the year 1786 was a Leap-year or not?

$$\begin{array}{r} 4)\,1786 \\ \hline 446\frac{2}{4} \end{array}$$

Note, That the two remaining ſhews the year 1786 to be the ſecond after Leap-year.

Example 2. Was the year 1784 Leap-year or not?

$$\begin{array}{r} 4)\,1784 \\ \hline 446 \\ \hline \end{array}$$

Note, That as there is no remainder, it ſhews that it was Leap-year.

As the ſeven firſt letters of the alphabet have been uſed to denote the 7 days of the week, the firſt of January being marked with A, the ſecond with B, and ſo on, ſo as that the ſame letter ſhall ſtand againſt the ſame day of the week throughout the year, whatever letter anſwers to the Sundays in any particular year is called the Dominical Letter, and in our almanacs is commonly printed with red. To find which, obſerve this diſtich:

Divide the year, alſo its 4th, by 7,
What's left, ſubtract from 7, the letter's given.

That is, if 1 remains, then it is A, if 2, B, and ſo on.

Example 1. What is the Dominical Letter for the year 1786?

1786
446 the 4th Part.

7)2232(318—6
Then from 7
Take 6

Leaves 1

Note, That the 4th part of the year, rejecting the remainder, is added to the year, and the ſum divided by 7, and the remainder after diviſion being 6, and that ſubtracted from 7 leaves 1, or the letter A for the Dominical Letter.

Example 2. What is the Dominical Letter for the year 1784?

1784
446 the 4th Part.

7)2230(318—4
Then from 7
Take 4

Leaves 3

Note, That in every Leap-year, which you may always know, if you can take the 4th part without any remainder, there are two dominical letters, of which the number found by this rule, anſwering to the letter C, is the latter, and takes place after the 24th of February, when the additional day is ſuppoſed to be inſerted into the calendar. For the firſt part of the year, the number 4 was the dominical number, and conſequently D the dominical letter.

Next to theſe, we may take notice of the Solar Cycle, which is a period of 28 years, being one of the numbers upon which the Julian period is founded. All the varieties of the dominical letters will happen within this and every thing relating to it return in the ſame order, according to the Julian account; but according to the reformed calendar, it will be interrupted in the years 1800 and 1900, becauſe they are only to be conſidered as common years, and not leap-years, as before in the Julian.

At the commencement of the Chriſtian æra, the 9th year of this cycle was juſt completed, and from hence we have the following rule for finding it:

To th' year add 9, the ſum if odd or even
Divide by 28, the Cycle's given.

That is, the remainder is the number of the cycle or if nothing, then 28 is the cycle.

Example. What was the cycle of the ſun for 1786;

```
        1786
Add        9
        ————
   28)1795(64
       168.
        ————
        115
        112
        ————
          3  Anſwer.
```

Again, we muſt notice the Lunar Cycle, or Cycle of the Moon, which is a period of 19 years, and is another of the numbers on which the Julian period was founded. All the variations of days on which the new and full moons happen will occur within this time, and fall on the ſame days as they did 19 years before. This is frequently called the Metonic Cycle, from its inventor *Meton* the Athenian. But the new and full moons which return on the ſame days, will happen 1 hour, 28 minutes, and 15 ſeconds ſooner than each preceding; and as this was productive of much confuſion, the reformed calendar rectified it. The years of this cycle were annexed to the old calendars throughout the year, and ſtill continue for one month from the 21ſt of March, or the limits within which the full moon next before Eaſter is always found. As the firſt year of the Golden Number was juſt completed at the commencement of the Chriſtian æra, the following rule for finding it naturally follows:

To the year, adding 1, if the ſum you divide
By 19, the remainder the *Prime* will decide.

Note, That the year of this cycle is frequently called the *Prime,* and more cammonly the *Golden Number,* becauſe it was annexed to the old calendars in golden characters.

Example. What was the Golden Nnmber for 1786?

1786
Add 1
19)1787(94
171
77
76
1 Anſwer.

Note, If nothing remains, then 19 is the Golden Number.

To theſe we may add the Epact, which is no other than the difference nearly between the number of days contained in a ſolar and lunar year; by which means it happens, that the Epact of any year is the moon's age on the firſt day of that year. In like manner, if we conſider the difference of time from new moon to new moon to be 30 days, which it nearly is, the moon's age may be eaſily obtained for any day in the year, by knowing the Epact, which increaſes every year by 11, rejecting 30 when neceſſary. When the Golden Number is 1, the Epact is 0.

The Epact, when the Golden Number is given, is thus found:

From the Prime taking 1, if by 3 you divide,
And nothing remains, will your Epact decide,
For the ſaid dividend; but for 1 left add 10
To the ſame dividend, and your Epact's had then.

That is, if 1 remains, 10 muſt be added to the dividend or the Epact, and if 2, add 20; but if nothing remains, hen the dividend, or 1 leſs than the Golden Number, is he Epact.

Example 1. What was the Epact for the year 1784, the Golden Number being 18?

Prime 18
Sub. 1
———
3)17(5
15
———
2 therefore add 20 to 17, which make 37, and 30 being rejected, the Epact is 7.

Example 2. What was the Epact for 1786, the Golden Number being 1?

Prime 1
Sub. 1
———
0, therefore the Epact is 0, becauſe as the dividend is a cypher, and ſo cannot be divided, conſequently nothing is to be added to it for the Epact.

Having found the Epact for the year, the moon's age may be readily obtained; as by the following diſtich:

Jan. 0, Feb. 2, Mar. 1, Ap. 2, May 3,
June 4, Jul. 5, Au. 6, Sep. 8, agree,
Oc. 8, No. 10, De. 10, to Epact add
And day, bate 30, Age or change is had.

That is to the Epact for the year, add the number annexed to each month, with the day of the month, and reject 30, if occaſion, when the difference will be the moon's age, or very near it.

Example 1. What was the Moon's Age on the 1ſt of April 1784?

The Epact	7
No. for the Month	2
Day of the Month	1
The Moon's Age	10 or nearly ſo.

Example 2. What was the Moon's Age on the 23d of May 1786?

The Epact	0
No. for the Month	3
Day of the Month	23
The Moon's Age	26

In like manner you may eaſily find the time of the Moon's coming to the ſouth, or the time when ſhe appears higheſt in the heavens, by means of this diſtich.

The Moon's Age by 4, if by 5 you divide,
The time of her Southing is nearly deſcry'd.

That is, 4 times the Moon's Age is to be divided by 5, and for every one remaining reckon 12 minutes, and the time from noon is obtained.

Example. At what time on the 23d of May 1786 did the Moon come to the South?

The Moon's Age 26
Mult. 4

5)104(20
10

4, or 20 hours, 48 minutes paſt noon, being 48 minutes paſt 8 o'clock of the following morning. But if you wiſh to know for that very morning, ſubtract 48 minutes, and that will leave 8 o'clock for the time of her ſouthing.

To theſe rules, it may be uſeful to add the method of finding Eaſter, as a matter highly neceſſary in ſubjects of chronology, or the adjuſting of hiſtorical facts to their proper periods of time.

Rule.] Having found the Epact for the year propoſed, if it is 23 or leſs, ſubtract it from 44, and the remainder will be the limit of Eaſter, or the day of the Paſchal full Moon; and if this limit or remainder exceeds 31, the full moon is in *April*; but if 31, or leſs, in *March*, and the Sunday following is *Eaſter-Day*. But if the Epact is exactly 24, ſubtract it from 73; and if it exceeds 24, ſubtract it from 74. Again, if the Epact is 25, and the Golden Number is 12, or more, ſubtract it from 73; but not otherwiſe.

Example 1. What was the time of *Eaſter* in the year 1784?

As the Epact for 1784 is 7, ſubtract that from 44, and the remainder 37 is the Paſchal limit, or day of full Moon; and if 31 be ſubtracted, it will leave 6, or the 6th of *April*, which being *Tueſday*, conſequently the *Sunday* following, being the 11th of April, is *Eaſter* day for that year.

Example 2. When was Eaſter celebrated in the year 1783?

The Epact for that year being 26, is to be taken from 74, and the remainder 48, after 31 (the days in March) are deducted, will give April 17th for the limit of Eaſter, which in that year was *Thurſday*; and therefore the *Sunday* following, or April 20th, was *Eaſter* day.

It only remains to take notice of the Roman Indiction, which is a period of 15 years, being the third number upon which the Julian period is founded. Of this Cycle 3 years were elapſed at the birth of Chriſt; and the knowledge of this is of great utility in adjuſting the chronology of the Roman hiſtory. To find this, take the following rule:

To the year increaſe 3, and by 15 divide,
What leaves does the year of Indiction decide.

Example. What is the year of Roman Indiction for 1786?

The year 1786
Add 3

15)1789(119
15
28
15
139
135

4 Anſwer; that is, 119 compleat periods have elapſed ſince the birth of Chriſt, and the year 1786 is the 4th year of another period.

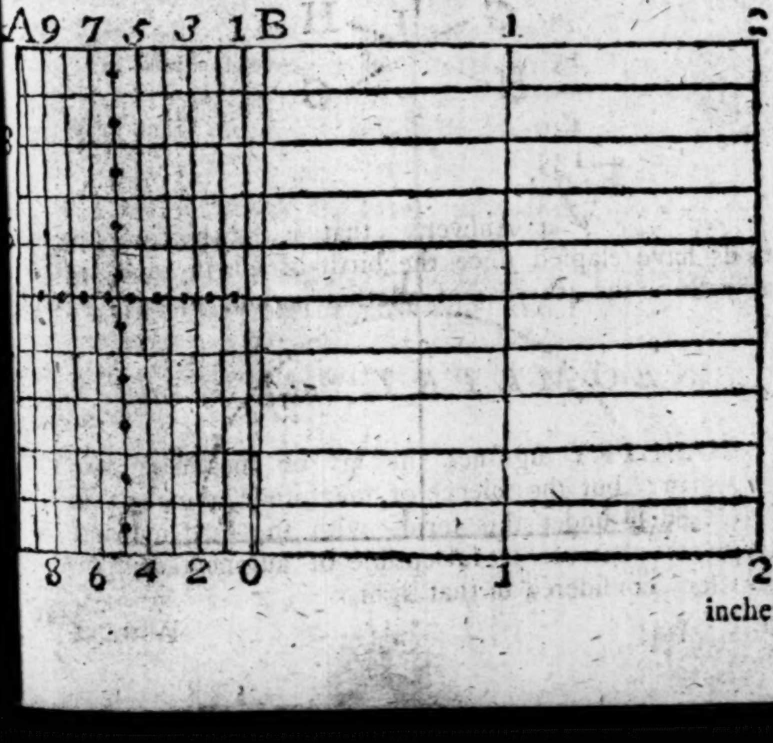
Of GEOMETRY, *and its Uſes.*

GEOMETRY ſignifies the art of meaſuring the earth; but the ſcience of magnitude in general is comprehended under this term, with the doctrine and relation of whatever is ſuſceptible of augmentation or diminution, conſidered in that light.

Without a moderate knowledge at leaſt of practical Geometry, in vain will the artificer, the mechanic, the architect, or any other artiſt, civil or military, pretend to judge of the nature and properties of things. But perhaps the principles generally neceſſary to a ſufficient acquaintance with the practical uſes to be made of it, may have been improperly extended; I ſhall therefore content myſelf with producing a few uſeful, practical problems, without which the artificer, mechanic, or artiſt, can never expect either to conceive a plan, or produce an eſtimate of any work of art.

Inſtruments of various kinds have been deviſed by men of ſcience, for the readier performance of works of this nature; but the ſcale of equal parts and the line of chords are moſt commonly uſed. The method of forming both theſe, with the lines, tangents, ſecants, ſemi-tangents ſhall be ſhewn as plainly as poſſible; for on theſe the operations in Geometry depend, and the ſeveral arts ariſing from thence.

To make a ſcale of equal parts, ſuppoſe of 10 in an inch, firſt ſet off the length you propoſe it to be in inches, and draw a line from A to B, and parallel to that, and at equal diſtances from each other, draw 10 more lines, each of the ſame length, and join them at each end by another line, which will form it into a long ſquare, as in the figure annexed. Then divide the whole line into



inches, or diviſions of 10 parts each, drawing lines directly acroſs; divide the firſt inch into 10 parts, both in the higheſt and loweſt line, and draw croſs lines diagonally, ſo that they may croſs from 0 to 1, from 1 to 2, &c. as in the figure, by which means each of thoſe parts is ſubdivided into 10 parts more, by meaſuring on the different parallel lines for the units figure of the meaſure to be taken. The ſcale may be extended from the B to the right hand, to any required or convenient length; and in like manner may any other ſcale be made to contain either more or leſs parts in an inch, and to any deſired length, the moſt common extent being 9 of thoſe large diviſions, to be reckoned from B. And thus may thoſe who cannot conveniently obtain inſtruments make ſuch for themſelves, only by means of compaſſes, as well as any other which are found on ſectors, ſcales, &c. for the mathematical ſtudent's aſſiſtance; and the correctneſs of ſuch lines may be aſcertained, or any error diſcovered. But before I proceed to ſhew the method of making lines of chords, &c. it will be adviſable to ſet the following problems before the reader.

Problem I. To raiſe a perpendicular, or upright line, from a given point in any ſtraight line, not too near the end of ſuch line.

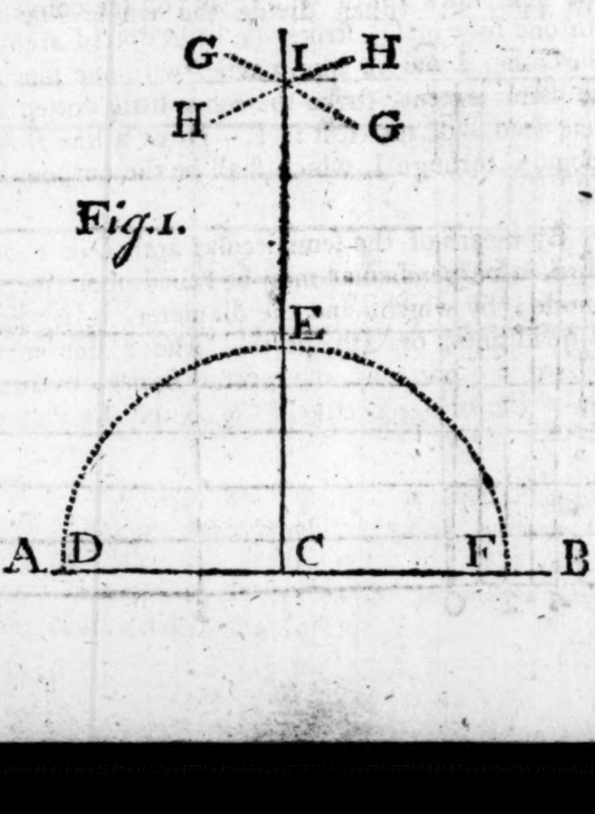
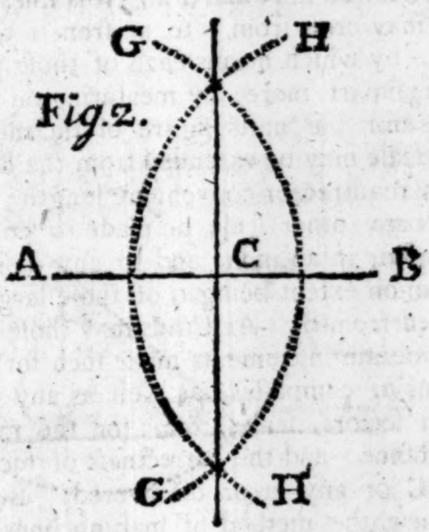


Fig. 1.

If

Fig. 2.



If the given line be A B, and the point at C, open the compaſſes to any convenient diſtance, ſuppoſe to D, and with one foot in C ſweep the ſemicircular arch D E F, (or the two marks D and F will do.) Then open the compaſſes a little wider, as you ſee convenient, and with one foot in D, ſtrike the little dotted arch G G with the other; and in like manner with one foot in F, and the ſame extent, ſtrike the other little dotted H H, and theſe two will interſect in I. Draw a line from the given point C through I, which ſhall be the perpendicular required.

Note, By means of the ſemicircular arch D E F of the firſt figure, a perpendicular may be raiſed upon the center of a circle; by which, and the diameter, it is divided into 4 quadrants, or 4th parts. Alſo a line may be divided into two parts by the ſecond figure, by making the ends of the line reſpectively the center of the arches.

PROBLEM II. To raiſe a perpendicular at or near the end of a line.

Fig. 1.

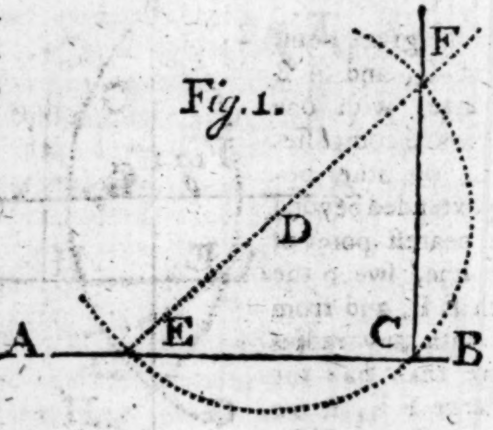
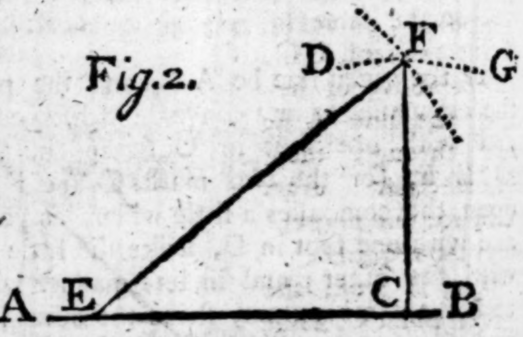


Fig. 2.



If the line given be A B, and the point at C, open the compaſſes to any convenient diſtance, and pitch the other foot any where above the line, as at D, which make a center, and with the diſtance C D ſweep the arch E C F, and draw a line from E, where it cuts the line A B through D to meet that arch in F; draw C F, which ſhall be the required perpendicular.—Or, take off from a ſcale of equal parts the number 4, or 40, in your compaſſes, from the point C towards A, which will extend to E, and with 3 or 30 taken from the ſame ſcale, and one foot in C, ſweep the little arch D G, and with 5 or 50, and one foot in E, extend it to meet the other arch in F, and through that and C draw a line for the perpendicular, and if the two points E and F were joined, it would be a right angled triangle.

Problem III. To let fall a perpendicular from any given point to any given right line at a convenient diſtance from it.

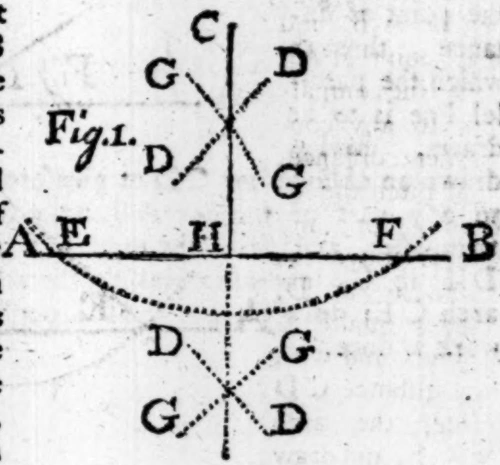


Fig.1.

If the given point be at C, and A B the line, with one foot of the compaſſes in C, the other being extended beyond the neareſt point of the line, ſweep the arch E F, and from F, with any radius more than half the diſtance F E, ſtrike the ſmall arch D D, and do the ſame in E for the arch GG, either above or below the line A B, and through theſe interſections draw CH for the perpendicular required.

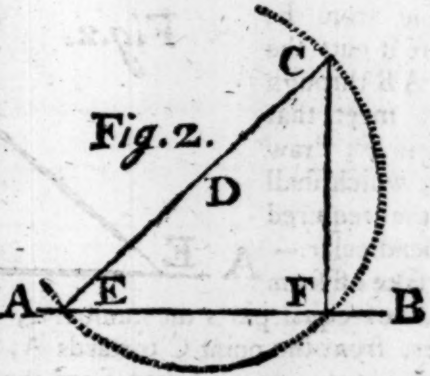
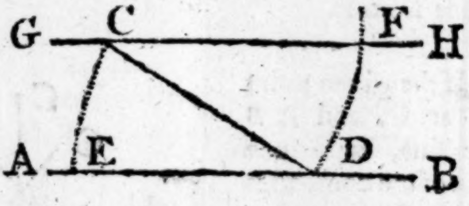


Fig.2.

Or, if from the given point C, a line be drawn in any direction to croſs the line given, as at E, if the diſtance C E be divided into two parts in the point D, as by Prob. I. ſet one foot of the compaſſes in D, opening the other to the point C, and deſcribe the arch C F E; then draw C F, where the arch cuts A B, and the perpendicular is obtained, as in Fig. II.

Problem IV. To draw a right line parallel to another given right line, at any aſſigned diſtance.



If A B be the line given, and C the point of diſtance through which the parallel line is to be drawn, having drawn an oblique line C D at pleaſure, from the point C to any part of the line A B, take that diſtance in your compaſſes, and ſtrike the arch C E in D, and the arch D F in C; and after making the arch D F equal to the arch C E, draw the line G H through C and F, and the work is done.

PROBLEM V. To divide a right line into any number of equal parts.

If the line AB is given to be divided into 7 equal parts, take the number 7 from any ſcale of equal parts longer than the given line in your compaſſes, ſuppoſe C D, and mark the diviſions accordingly; then take the line CD, and with one foot in C, ſweep the arch F F, and again with one foot in D ſweep the other arch G G, which will interſect each other in E; and having joined C E and DE, take the given line A B in your compaſſes, moving the points ſo that it may be parallel to C D, its ends being in the lines C E and D E, which join; then draw lines from the diviſion marks in C D, through A B, to E, and thus will it be divided into ſo many equal parts.

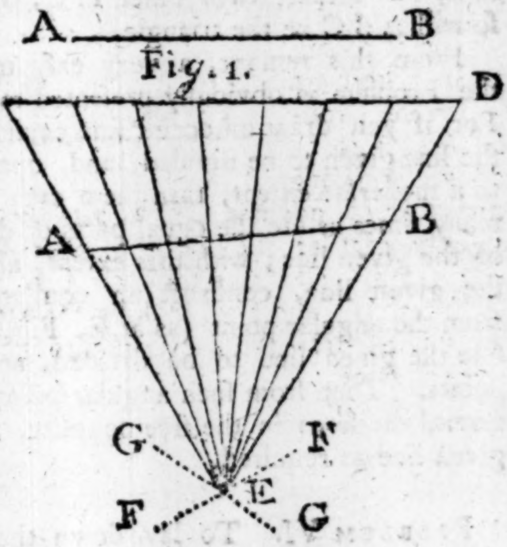


Fig. 1.

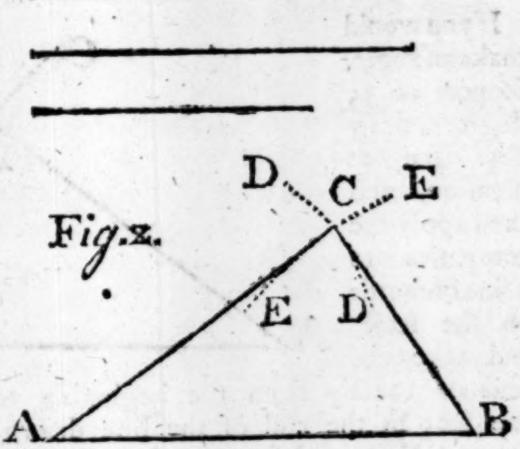
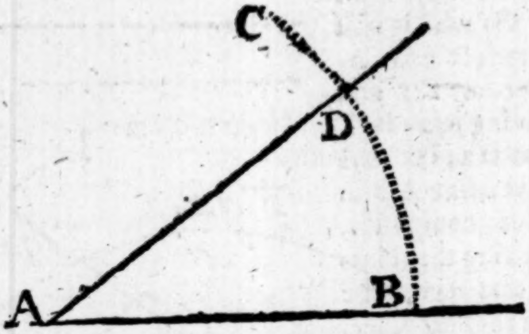


Fig. 2.

Note, C D E being joined, will make an equilateral triangle; and thus, if one ſide be given, any other equal-ſided triangle may be drawn. Any other triangle may alſo be drawn after the ſame manner, the three ſides being given; for if any ſide, as A B in Fig. II. be firſt laid down, and one of the ſides, as A C, be taken in your compaſſes, ſweep the arch D D, and the remaining ſide being alſo taken, with one foot in B ſweep the arch E E, interſecting each other in C, draw A C and B C, ſo will A B C be the triangle.

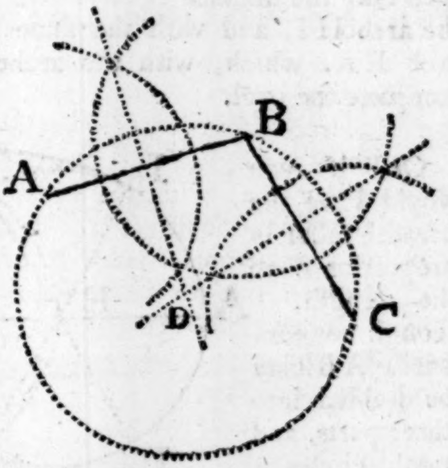
From this remark, a very eaſy method of reſolving the Problem is obviouſly preſented to the young ſtudent. For if you draw an occult line conſiderably longer than the line given to be divided, and, opening the compaſſes to a moderate extent, turn them over upon ſuch line as many times as are the equal parts or diviſions to be made of the given line; with this extent, always greater than the given line, conſtruct an equilateral triangle, and from the angular point (as at E, Fig. 1) ſet off on each ſide the given line to be divided, and join the extreme points. Then from ſuch angular point draw lines to the ſeveral diviſions in the ſide oppoſite, which ſhall cut the given line as required.

Problem VI. To lay down the quantity of any propoſed angle.



If you would make an angle, ſuppoſe of 35 degrees, draw any line at pleaſure, and then apply the compaſſes to a line of chords on the ſcale, and take the diſtance exactly from the beginning to 60, and with one foot in the end of the line drawn, as at A, ſweep the arch B C, and from the ſame line of chords take 35, which ſet off on the arch from B to D. Then, by drawing a line from A through D, an angle of 35 degrees will be formed at A. In this manner may the meaſure of any angle be taken.

Problem VII. To find the center of a circle which ſhall be equally diſtant from any three given points, not in a right line, and through which, with that diſtance as a radius, the circumference of ſuch circle may be drawn.



If A, B, and C, be the three given points, biſect the diſtance A B, and alſo the diſtance B C, as by Problem I. Fig. 2. and draw lines inward, till they interſect each other in D, which will be the center required; then with the diſtance D A, DB, or DC, (for they are all equal) draw the circle required to paſs through all the given points. After the ſame manner may be found the center of a circle which will circumſcribe any given triangle.

Problem VIII. To make an ellipſis, or oval, either by having the longeſt diameter given only, or the ſhorteſt only, or both.

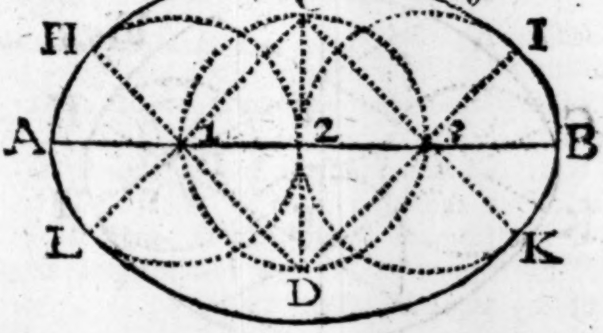


Fig. 1.

1. If the length only be given, equal to AB, divide the ſaid line into four parts, and thereon draw three

ſmall

ſmall circles on the diviſions 1, 2, and 3, as centers, on the middle of which raiſe a perpendicular; and from C and D, where it reaches the circumference of the middle circle, draw lines through the centers of the two outermoſt circles, to their extremes in H, I, K, and L; then take the diſtance D H in your compaſſes, and ſweep the arch H I, and with the ſame radius in C ſweep the arch K L, which, with the arches H L and I K, will complete the oval.

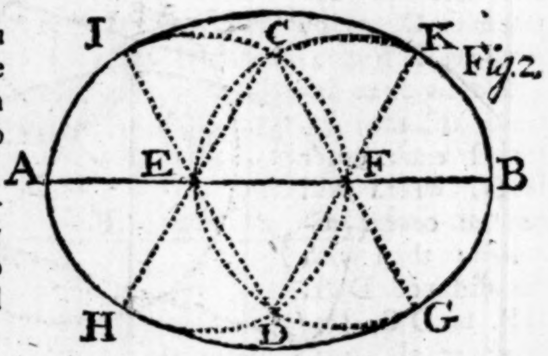


Fig. 2.

Or, if you would have the breadth fuller in proportion to the length, though not confined, A B may be divided into three parts, and two circles drawn upon it; and from the interſecting points C and D, through the centers E and F, draw lines to G and H, and to I and K; and with the diſtance C G in your compaſſes, ſweep the arch G H, and with the ſame radius in D deſcribe I K, to finiſh the oval.

2. If the breadth only be given, draw two ſmall circles, with a radius of one fourth of ſuch breadth, ſo that their circumference may juſt touch each other,

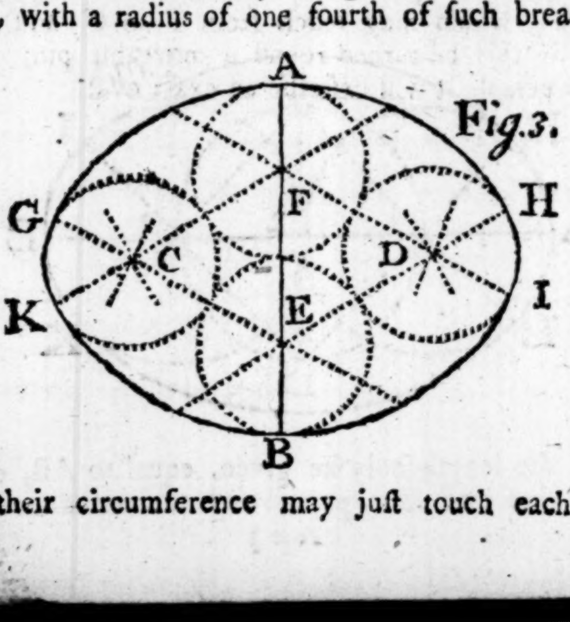
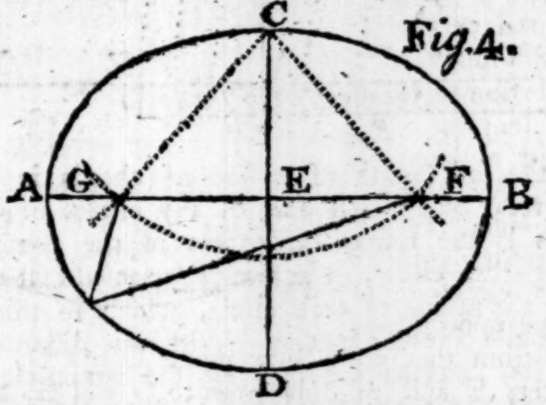


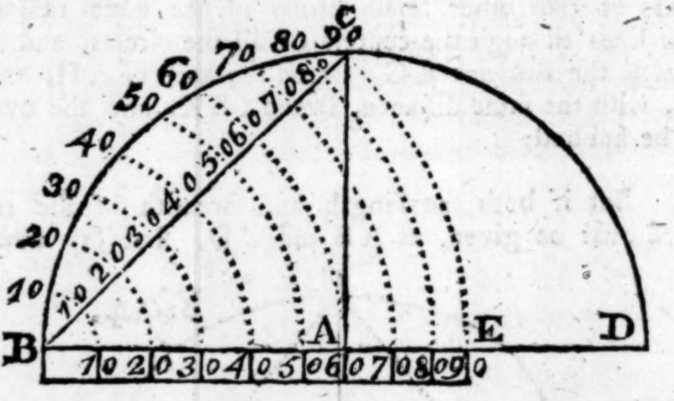
Fig. 3.

and with the diſtance of their centers, and with one foot of the compaſſes in each center, ſtrike the little arches to interſect each other in C and D, which ſhall be the centers of two other ſmall circles of the ſame radius. Draw lines through the centers of all the circles, and in E, with the diſtance E G, ſweep the arch G A H, and in F, with the ſame diſtance, ſweep I B K, and the oval will be finiſhed.

3. But if both the length and breadth of the required oval be given, as A B and C D, firſt lay down A B, and biſect it in E, ſetting off the half of the given breadth each way from E, to C and D; take A E, viz. half A B, in your compaſſes, and with one foot in C or D ſweep the arch F G, to cut the line A B in F and G. Fix two pins at F and G, and round them a ſilk thread, which may reach from F to C, and thence to G; if this be turned round a moveable pin, or a black lead pencil, it will deſcribe an exact oval.



Problem IX. To make a line of chords, by the compaſſes alone, to any length required; ſuppoſe A B.

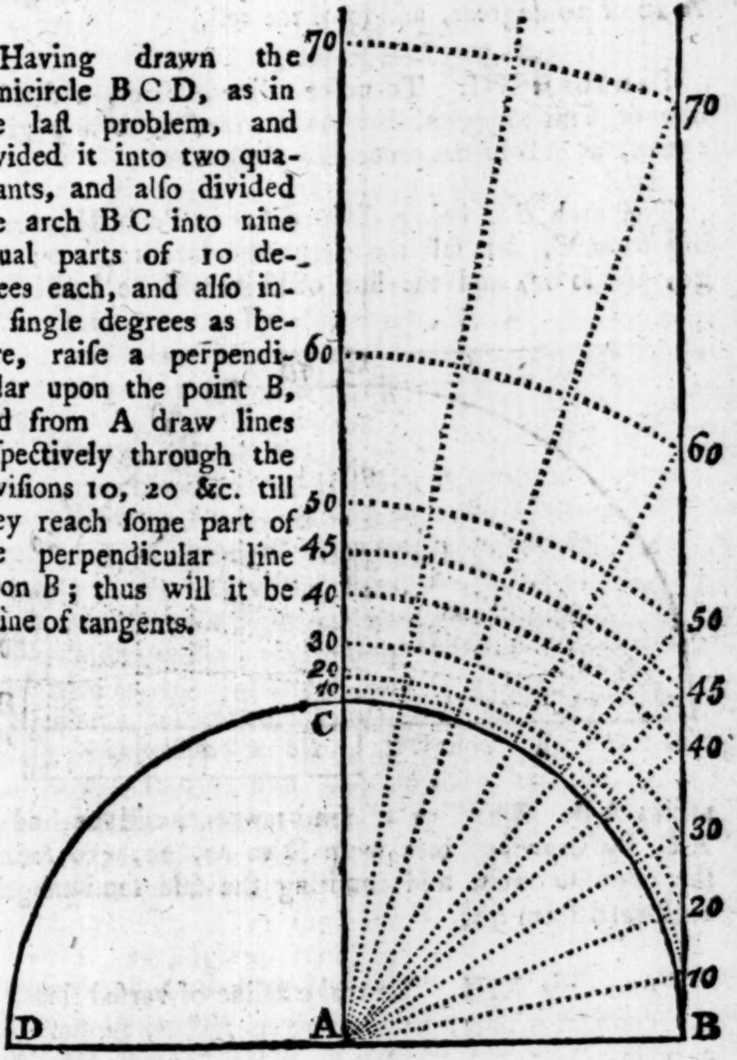


As the full length of a line of chords is equal to 90 degrees, or the 4th part of any circle, of which 60 degrees is the radius, or extent of the compaſſes for drawing that circle, it is always ſuppoſed that the given line is the radius of ſuch circle, which in this caſe is A B in the figure annexed. With this diſtance in your compaſſes, deſcribe the arch of the ſemicircle B C D, and erect the perpendicular A C upon the center, firſt drawing D B through A to complete the ſemicircle. Then divide the arch B C into nine equal parts of 10 degrees each, and each of theſe into 10 parts, or ſingle degrees, and upon B as a center, with the ſeveral diſtances, B 10, B 20, &c. ſweep the arches as in the figure, and the line B C, or B E, ſhall be the line of chords required.

Note. That every circle is ſuppoſed to be divided into 360 equal parts, as the globe of the earth is, and each quarter is conſequently 90 degrees, and the radius, or half diameter, is always 60; and each degree is ſuppoſed again to be divided into 60 equal parts, called minutes.

Problem X. To make a line of tangents, by the compaſſes only, to any radius required; ſuppoſe A B, as in the laſt problem.

Having drawn the ſemicircle B C D, as in the laſt problem, and divided it into two quadrants, and alſo divided the arch B C into nine equal parts of 10 degrees each, and alſo into ſingle degrees as before, raiſe a perpendicular upon the point B, and from A draw lines reſpectively through the diviſions 10, 20 &c. till they reach ſome part of the perpendicular line upon B; thus will it be a line of tangents.

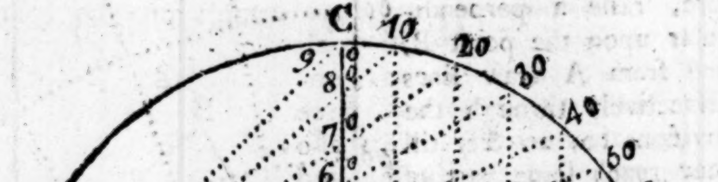


Problem XI. To make a line of ſecants, by the compaſſes alone, to any radius, ſuppoſe A B, as before.

The line of tangents being had, as in the laſt problem, continue the perpendicular A C at pleaſure; then with one foot of the compaſſes in A, extend the other to 10, 20, 30. &c. on the tangent line, and therewith ſweep the arches 10, 10; 20, 20; 30, 30, &c. ſo ſhall A C continued be a line of ſecants to the ſaid radius, the diſtance A 10 being the ſecant of 10 degrees, A 20 of 20 degrees, and ſo of the reſt.

Problem XII. To make a line of ſines, and alſo a line of ſemi-tangents, by the compaſſes, to any given radius, as A B in the preceding Problems.

The arch B C being divided, as in Prob. IX. counting from C, let fall the perpendiculars 10, 10; 20, 20, and ſo on, and the line of ſines will be had on the radius A B. The line of ſemi-tangents will be had on A C, by drawing lines from D to 10, 20, 30, &c. in the oppoſite arch, and counting the ſaid ſemi-tangents backward from 90.



Problem XIII. To make a line of verſed ſines, by the compaſſes only, from a given radius, ſuppoſe A B as before.

Having drawn the line of ſines, as by the laſt problem, let the center at A be called 90, and the diviſion at 10 be 100, and ſo on, that the end of the line B ſhall be 180; and by dividing D C into 90 equal parts, as the other, and letting fall perpendiculars to D A, the firſt diviſion from D is 10, the next 20, and ſo on, till you come to A, which is 90, ſo ſhall the whole line D A B be the verſed line of 180 degrees to the radius A B.

Thus the ſeveral lines are obtained, uſually put upon plain ſcales, or ſectors, which are of the greateſt uſe in every branch of practical Mathematics. And thus much may ſuffice for the Geometrical part; we ſhall now proceed to Trigonometry.

Of Plain Trigonometry.

THE doctrine of Plain Triangles, which conſtitutes Plain Trigonometry, is of the utmoſt utility. A plain triangle then conſiſts of three ſtrait ſides, as Fig. 1, 2, 3, 4, or 5, all of which are plain triangles, conſiſting of three ſides and three angles, of which Fig. 1. is alſo called an oblique triangle, and hath all its ſides unequal. In like manner Fig. 2, hath all its ſides equal, and is called an equilateral triangle. Fig. 3 hath two of its ſides equal, the third being greater or leſs, and is called an iſoſceles triangle. Fig. 4 is a right angled triangle, in which two of its ſides muſt be perpendicular to each other at their junction, and may have all its ſides unequal, as Fig. 1, or the two legs equal, as Fig. 3, but can never be ſimiliar to Fig. 2; alſo Fig 5 is an obtuſe angled triangle, the largeſt angle being greater than that of Fig 4, or more than 90 degrees, as a right angled triangle is always equal to it. An acute angle is leſs than 90 degrees.

Fig. 1

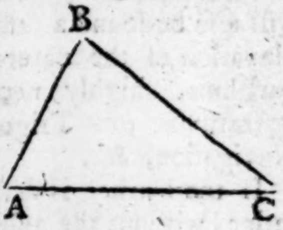


Fig. 2.

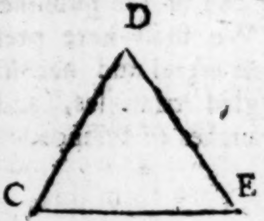
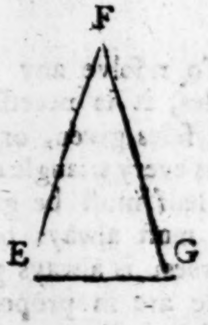


Fig. 3.



It muſt be noted, that the three angles of every plain triangle are equal to two right angles; that is, to twice 90, or 180 degrees; ſo that if two of the angles are known, the third is known by ſubtracting the ſum of the other two. The quantity of any angle is obtained by Prob VI. of Geometry; and other particulars, too numerous to be obſerved here, may be known under the heads of Geometry and Trigonometry, in the laſt edition of Mr. Fenning's Young Man's Book of Knowledge, page 240, and forwards, and at page 270, &c. will alſo be found a ſufficient explanation of the nature of Logarithms, highly neceſſary in operations of Trigonometry, Navigation, &c.

Fig. 4.

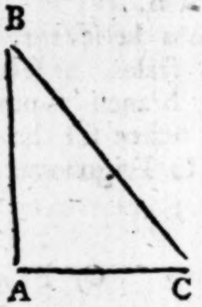
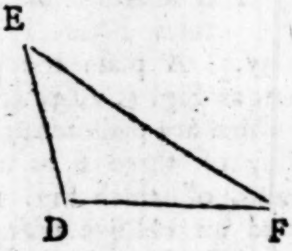


Fig. 5.



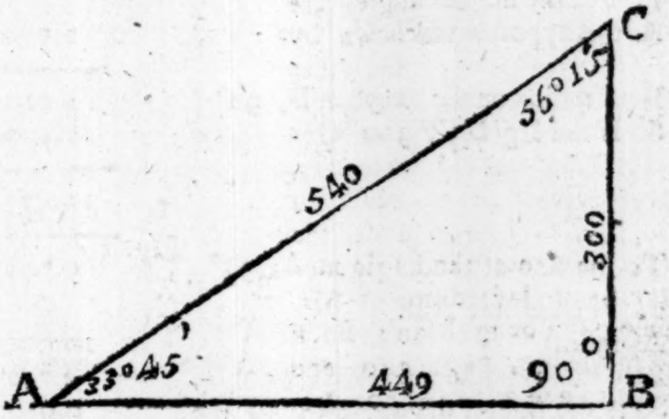
If the learner is deſirous of performing the ſame operations without the aſſiſtance of Logarithms, he may conſult Mr. Turner's Treatiſe of Plain Trigonometry, to be had of the publiſhers of this Work.

We ſhall here preſent the reader with a few of the moſt uſeful and neceſſary Problems in right and oblique-angled triangles, and then paſs on to the dependent branches of ſcience.

Of right angled Plain Triangles.

To reſolve any Problem relating to right-angled triangles, it is neceſſary, beſides the right angle, to have two ſides given, or an angle and a ſide, to find the reſt; for as every triangle conſiſts of three ſides and three angles, one half muſt be given to find the other, in which one ſide muſt always be given, and the right angle, or 90 degrees, is always given. The ſides of every plain triangle are in proportion to the ſines of their oppoſite angles.

Problem I. Given the ſide A B, and the hypothenuſe A C, of the right-angled triangle A B C, to find B C, and alſo the angles at A and C.



2. To find the angle C.

As the hypothenuſe A C, 540	2.732394
Is to radius, or the angle at B, 90°	10.000000
So is the leg or ſide A B, 449	2.652246
	12.652246
To the ſine of the angle at C, 56° 15′	9.919852

Note, That the complement of one of the acute angles to 90°, is equal to the other acute angle of every right-angled triangle; therefore the angle at A will be 33° 45′

2. To find the ſide B C.

As radius, or the angle at B,	10.000000
Is to A C, its oppoſite ſide, 540	2.732394
So is the ſine of the angle at A, 33° 45′	9.744739
To the leg or ſide B C, 300	2.477133

Note, That when the firſt term is radius, or the logarithm ſine of 90°, the operation may be eaſily found by Addition, only leaving out 10 in the index.

Problem II. Given the hypothenuſe A C as before, and the leg or ſide B C 300, to find the other leg A B, and the angles A and C.

1. For the angle C.	
As the hypothenuſe A C, 540	2.732394
Is to radius or the angle at B, 90°.	10.000000
So is the leg B C, 300	2.477121
	12.477121
To the ſine of the angle at A, 33° 45′	9.744727
2. For the ſide A B.	
As radius	10.000000
Is to the hypothenuſe A C, 540	2.732394
So is the ſine of the angle C, 56° 15′	9.919846
To the ſide A B, 449	2.652240

Problem III. Given the two legs A B and B C, as before, to find the hypothenuſe A C, and the angles at A and C.

1. For the angle at A.	
As the ſide A B, 449	2.652246
Is to radius	10.000000
So is the ſide B C, 300	2.477121
	12.477121
To the tangent of the angle A, 33° 45′	9.824875
2. For the hypothenuſe A C.	
As the ſine of the angle A, 33° 45′	9.744739
Is to the ſide B C, 300	2.477121
So is radius, or ſine of 90°	10.000000
	12.477121
To the hypothenuſe A C, 540	2.732382

Problem IV. Given one of the acute angles, ſuppoſe C, as before, and the leg A B, to find the other leg B C, and the hypothenuſe A C.

1. To find B C

As the ſine of the angle C, 56° 15′	9.919846
Is to A B, 449	2.652246
So is the ſine of the angle A, 33° 45′	9.744739
	12.396985
To B C, 300	2.477139

2. To find the hypothenuſe A C.

As the ſine of the angle C, 56° 15′	9.919846
Is to the ſide A B, 449	2.652246
So is radius, or the ſine of 90°	10.000000
	12.652246
To the hypothenuſe A C, 540	2.732400

Problem V. Given one of the acute angles, ſuppoſe C, as before, with the hypothenuſe A C, to find the two legs.

1. To find A B.

As radius	10.000000
Is to the hypothenuſe A C, 540	2.732394
So is the ſine of the angle C, 56° 15′	9.919846
To the leg or ſide A B, 449	2.652240

2. To find the perpendicular B C.

As radius	10.000000
Is to the hypothenuſe A C, 540	2.732394
So is the ſine of the angle A, 33° 45′	9.744739
To the perpendicular B C, 300	2.477133

Theſe Problems, with their operations, will be abundantly ſufficient for all the common purpoſes of Navigation, Aſtronomy, Dialling, &c. ſo far as they depend upon Plain Trigonometry; but becauſe we have one uſeful Problem for finding the third ſide of a right-angled triangle, when two of the ſides are given, without finding the acute angles, and as it is an exemplification of the Square-Root, to which reference has been made, it is here added.

PROBLEM VI. Given two of the ſides of a right-angled triangle, to find the third ſide.

Rule. If both the legs are given, ſquare them ſingly, and extract the Square-Root of their ſum for the hypothenuſe; but if the hypothenuſe be given, and one of the legs, ſquare them ſingly, and extract the Square-Root of their difference for the other leg.

Example 1. If the height of any fort or tower is known to be 40 feet, and the breadth of a moat, foſs, or ditch in front of it is 30 feet; of what length muſt be a ladder to reach from the oppoſite bank to the top of the tower?

```
      40        30
      40        30
     ————      ————
     1600       900
Add   900
     ————
     2500(50  Anſwer.
     25
     ————
100)  00
```

Example 2. If the height of the tower and length of the ladder be known, to find the breadth of the ditch.

40   50
40   50
1600   2500
1600 Sub.
900(30 Feet, Anſw.
9
60)00

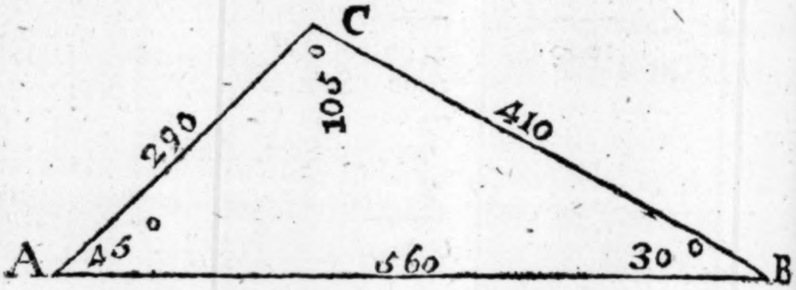
In like manner, the height of the fort or tower may be found, by knowing the length of the ladder and breadth of the foſs.

The diſtance of any place may alſo be found, though you cannot meaſure it, in the following manner: having fixed your firſt ſtation, and directed your eye to any certain point of your object, move backwards or forwards, at right angles, to the line pointing out ſuch object, till you can ſee the object and your firſt ſtation making an angle of 45°; and then the diſtance of thoſe ſtations will be equal to the diſtance from the firſt ſtation to the object. But if you cannot ſee the object with that angle, take the quantity of any other angle, which, by meaſuring the diſtance of the two ſtations, and proceeding as under Problem IV. will give the diſtance of your firſt ſtation from the object.

Of oblique-angled Plain Triangles.

For reſolving any Problem in an oblique-angled plain triangle, three things muſt always be known to find the other three; but one or more ſides muſt be given, though it is not always neceſſary for an angle to be known. If any one angle is obtuſe, or more than 90°, take the ſupplement of it to 180 in the operation.

Problem I. Given one ſide A B of the oblique-angled triangle A B C equal to 560, with the angle at A 45°, and the angle at B 30°, to find the ſides A C and B C.



1. For the ſide A C.

As the S. of the angle C, 105° or 75°	9.984944
Is to its oppoſite ſide A B, 560°	2.748188
So is the S. of the angle B, 30°	9.698970
	12.447158
To the ſide A C, 290	2.462214

Note, That as the three angles of every plain triangle, whether right angled or oblique, are equal to 180°, conſequently as the angles A and B are both equal to 75°, the angle C muſt be 105°, and its complement to 180 equal to 75°.

2. For the ſide B C.

As the S. of the angle C, 105° or 75°	9.984944
Is to its oppoſite ſide A B, 560	2.748188
So is the S. of the angle A, 45°	9.849485
	12.597673
To the ſide B C, 410	2.612729

Problem II. Given the ſides A C and B C of the triangle A B C, with the angle A, oppoſite to B C, to find the angles B and C, and the ſide A B.

1. For the angle B.

As the ſide B C, 410	2.612784
Is to the S. of its oppoſite angle A, 45°	9.849485
So is the ſide A C, 290	2.462398
	12.311883
To its oppoſite angle B, 30°	9.699099

Note, That the ſum of the angles A and B being 75°, the complement to 180 or 105° muſt be the third angle, or the angle at C.

2. For the ſide A B.

As the S. of the angle A, 45°	9.849485
Is to the ſide B C, 410	2.612784
So is the S. of the angle C, 105° or 75°	9.984944
	12.597728
To the ſide A B, 560	2.748243

Problem III. Given the ſides A C and B C, with the angle C included, to find the angles A and B and the ſide A B.

To find the angles.

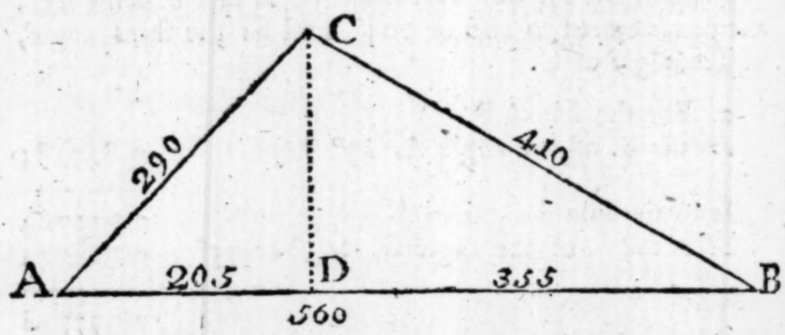
As the ſum of the two ſides A C and B C, 700	2.845098
Is to their difference, 120	2.079181
So is the tangent of half the ſum of the angles required, or 37° 30′	9.884980
	11.964161
To the tangent of half their difference, 7° 30′	9.119063

which being ſubtracted from the half ſum, will leave 30° for the leſſer angle; and as the ſide A C is leaſt, is conſequently the meaſure of its oppoſite angle B. Add this to the angle C, and the ſum taken from 180 will leave 45° for the angle A.

Note, That the leaſt angle ſhould always be found firſt; becauſe if either of the angles required is obtuſe, the ſum of theſe two taken from 180 will leave the greater of the angles required, without the poſſibility of miſtake.

Having found the angles, the ſide A B may be found by the preceding Problem.

Problem IV. Given the three ſides of an oblique angled plain triangle, to find any of the angles.



It will be neceſſary to divide the greateſt ſide A B into two parts, by a perpendicular C D let fall from C, and then you will have two right angled triangles A C D and B C D, with which proceed thus:

As the ſide A B, 560	2.748188
Is to the ſum of the other two ſides, 700	2.845098
So is their difference, 120	2.079181
	4.924279
To the difference of the ſegments of the baſe, 150	2.176091

If this be ſubtracted from 560, the whole baſe, half the remainder will be 205, or the ſegment A D. Alſo if it be added to 560, half the ſum will be 355, equal to D B. Then you will have two right-angled plain triangles, of which the baſe and hypothenuſe are given, to find the angle A or B; and conſequently the angle C, by Problem II. of right-angled plain triangles already given.

GEOGRAPHY,

THE ſcience that teaches and explains the nature and properties of the earth, as to its figure, place, magnitude, motions, celeſtial appearances, &c. with the various lines, real or imaginary on its ſurface. Geography is diſtinguiſhed from Coſmography, as a part from the whole; this latter conſidering the whole viſible world, both heaven and earth; and from Topography and Chorography it is diſtinguiſhed as the whole from a part.

As our limits will not admit of a copious illuſtration, the ſtudent is here preſented with a few ſhort and plain leſſons, relative to the underſtanding of maps, &c. ſo generally uſeful to mankind.

LESSON I.

Maps are deſigned to point out by inſpection the diſtance and ſituation of different countries and kingdoms, or of different diviſions, diſtricts, or places in the ſame countries or kingdoms. Charts in like manner are uſed to point out the ſame things upon the ſeas, or the ſituation of different ports on the ſea coaſt; and ſerve to ſhew the diſtance of ports from each other, either on the coaſts of the ſame kingdom, or thoſe of greater diſtance.

All maps and charts ſhould be ſo laid down, that the northern countries or places may appear towards the top, and places and countries ſouthward towards the bottom of your paper or draught; and conſequently ſuch as lay eaſtward muſt be ſituated on the right-hand, and thoſe weſtward on the left.

In all caſes where maps and charts are not laid down exactly in this manner, a circular figure, repreſenting a compaſs, having a fleur-de-lis to point out the true northerly direction, is always placed in ſome vacant part of all modern maps. Thoſe which are truly drawn, (agreeable to the general method) are ſometimes decorated with one or more of theſe compaſſes ſo ſupplied.

LESSON II.

All places which lay in a line exactly eaſt and weſt of each other, are ſaid to be in the ſame latitude, and thoſe which are exactly north and ſouth, in the ſame longitude.

Latitude is the diſtance of any place from an imaginary circle which is ſuppoſed to ſurround the earth and ſeas, called the Equator, and is ſouth or north according to its direction from that circle. The Equator, ſometimes called *The Equinoctial Line*, and by ſeamen ſimply *The Line*, is in the higheſt part of the globe, and equally diſtant from two points on its ſurface, called the North and South Poles, on which, as an axis, the earth turns round every 24 hours; which rotation occaſions thoſe different appearances of riſing and ſetting of the ſun, daily experienced by all the inhabitants between the Tropics*. Longitude is the diſtance of any place from another given place, whether eaſt or weſt.

All places, therefore, which do not lay directly north and ſouth, differ from each other in longitude, as thoſe which are not in a line directly eaſt and weſt differ in latitude; conſequently thoſe which are not exactly ſituated from each other in either direction, differ in both.

Places which are exactly north and ſouth are ſaid to lie on the ſame meridian, becauſe they have mid-day, or 12 o'Clock, at the ſame time; but there are as many different meridians as there are places in the world differing in longitude, every point having its proper meridian, the two poles only excepted, where all thoſe meridians unite as a center.

Maps are to be recommended as the readieſt method of learning Geography; there utility at leaſt cannot be denied. Theſe are generally delineated for ſome particular meridian; and ſuch as are printed for England, Scotland, Ireland, or the Britiſh iſles, commonly reckon the longitude from London, or that line which is ſuppoſed when drawn from pole to pole to paſs through London. Moſt foreign maps, particularly thoſe printed for France, or other parts of the continent of Europe, and in general for the four quarters of the world, have there firſt meridian drawn through Ferro, the moſt weſterly iſland of the Canaries. Maps of the world, eſpecially ſuch as are projected in two hemiſpheres on the plane of the general meridian, are moſtly drawn in this manner; and by this method the three quarters of Europe, Aſia, and Africa, are entirely comprehended in one of them, and that of America in the other.—So much for the outlines.

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* What the tropics are, with other imaginary circles, not here explained, may be ſeen in Mr. Fenning's Young Man's Book of Knowledge, and his Uſe of the Globes. For a general knowledge of maps, the preſent deſcription will be ſufficient.

LESSON III.

In proceeding to the particulars, it muſt be obſerved, that the latitude of places is moſtly marked in degrees and minutes on the weſt and eaſt ſides of our maps, as the longitude is on the north and ſouth limits; but this is ſometimes given in hours and minutes of time, to ſhew the difference of time in which the ſun appears reſpectively on the meridians of thoſe places. In maps of counties, or ſmall diſtricts of countries, which include only a ſmall compaſs, a ſcale * is frequently introduced to ſhew the diſtance of places in miles, &c, and the marginal references are ſometimes omitted.

The diſtance from the equator to the poles is divided into 90 degrees, aud each degree is ſubdivided into 60 minutes, or geographical miles, each being nearly one ſixth more than an Engliſh ſtatute mile. By this diviſion, the whole circle of the globe contains 360 degrees, into which every circle is ſuppoſed to be divided; and the ſituation of places betwixt the equator and the poles, each way, is determined by the degrees and minutes of diſtance from the part of the equator neareſt ſuch place, being that which lies on the ſame meridian. This is what diſtinguiſhes the latitude. The longitude is divided each way from ſome particular meridian, for which the map is conſtructed, into 180 degrees eaſt or weſt; but theſe degrees are very unequal, for although at the equator they are the ſame as thoſe of the latitude, they gradually decreaſe towards each pole, where the different meridian

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* When this ſcale is omitted, as may frequently be the caſe in provincial maps, or maps of counties, travelling pocket maps, &c. the deficiency is ſupplied commonly by laying down the diſtances in the body of ſuch maps regularly between the ſeveral towns or places of note. Many of our maps of England have been printed in this manner.

lines terminate, and where conſequently there is no ſuch thing as longitude. Hence it is, that in large maps, which include a conſiderable extent of earth or ſea, the parallels of latitude and longitude, generally drawn through every 10 degrees, always appear curvilinear, as they are deſcribed on globes.

We are next to conſider the ſituation of remarkable places, with their bearing and diſtance from each other. For this purpoſe, the nature of provincial maps, or maps of counties and ſmall diſtricts, ſhould be fully underſtood; the latitude of the principal city or town it contains ſhould be exactly known as the baſis or foundation, and its longitude, if any, from ſome known cuſtomary meridian. Having then conſidered the bearing and diſtance of any other cities, boroughs, or market towns therein contained, it will be eaſy to find the particular ſituation of any ſmaller town or village, and the exact place of the map on which it is or ought to be delineated. And thus much may ſuffice for the nature of ſmall maps.

LESSON IV.

In treating of larger maps, we ſhall begin with thoſe which only extend to any one particular ſtate or kingdom. The firſt object, as before in provincial maps, is to find out the principal city or town in each diſtrict, diviſion, or county, and the ſituation and extent of each particular diſtrict.

To illuſtrate this, let the counties of England ſupply the ſtudent with ſuitable obſervations. The latitude of London, the metropolis of the kingdom, being known, and the firſt meridian being ſuppoſed to paſs through it, from which the longitude is to be reckoned, conſider the ſituation of the ſeveral counties; thoſe upon the ſea coaſt are the firſt which ſhould merit our notice, with their bearing and diſtance from the capital of the kingdom. The extent of each in length and breadth ſhould be attended to, with the counties bordering upon them, whether coaſt-ways or inland, and on what ſide they are ſituated. Inland counties, which are ſeparated from the ſea, ſhould be compared with the counties that ſurround them; and the diſtance of the ſeveral cities or county towns from each other, with their relative ſituation, ſhould be obſerved. By conſidering the ſituation of the ſeveral counties bordering on the capital or metropolis of the kingdom after the ſame manner, the general ſtate of all the counties in the kingdom will be attained.

These obſervations muſt be equally true in examining the maps of any other kingdom or ſtate. The ſame method muſt be purſued in order to a general knowledge of the nature of ſuch kingdom or ſtate. No perſon can be at a loſs to underſtand the maps of any kingdom or country, after paying a due attention to theſe remarks; and the ſeveral diſtricts and diviſions into which ſuch country is divided, muſt in like manner be as certainly known.

Diſſection of maps * has been much recommended, as of ſingular advantage towards attaining a proper knowledge of their nature and uſe. A few general remarks may be made on this ſpecies or mode of inſtruction, as tending to facilitate the knowledge of maps.

All maps are or ought to be ſo conſtructed, that, when divided into fragments or parcels, the names of places may for the moſt part appear in a proper poſition, when the moſt northerly places are towards the top, or at the fartheſt diſtance from the eye. Hence the poſition of the ſeveral parts will become obvious from the preceding obſervations. Some particular place ſhould be here noticed alſo as the baſis of the reſt, and the center, as it were, of every other leſs diſtinguiſhed town or village, from whence the reſpective direction muſt be made. Thus will every diſtinct part adjoining be neceſſarily and unavoidably evident, and the knowledge of the ſituation of any remarkable city, town, or village muſt be certain; the ſtudent is thus naturally directed in the attainment of uſeful knowledge, and inſenſibly ſurprized into an ac-

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* Diſſection of ſmall maps, as thoſe of counties into their ſeveral hundreds, tythings, wapontakes, laths, or other ſubdiviſions, by whatever names or titles they are called or diſtinguiſhed, are not generally to be approved of. However neceſſary the knowledge of theſe may be with reſpect to the internal police of the kingdom in a civil ſenſe, as being anciently eſtabliſhed, they are ſeldom of importance ſufficient, when conſidered in relation to the geography of modern times, to become the ſubjects of general ſtudy. The maps of kingdoms may be diſſected into their ſeveral counties or provinces, and thoſe of the different quarters of the world into their ſeveral kingdoms; in other caſes, the ſtudent may uſe this method or not, as he thinks beſt, as I do not preſume either to recommend or condemn it.

quaintance with that which preſented at a diſtance the moſt unfriendly and forbidding aſpect. The ſame method, if regularly purſued through each diviſion, province, or diſtrict, will readily direct to the uſe of the moſt complicated and extenſive map, in this diſſected ſtate, and give to each city, town, or village, its proper place and ſituation in the general deſcription.

LESSON V.

A few things remain to be remarked of the maps of counties and ſmall diſtricts, which may not be wholly unworthy our attention. The ſeveral ſubdiviſions into which theſe limited and confined maps are ſeparated ſhould be particularly noted, and the various names and characteriſtics by which they are reſpectively diſtinguiſhed carefully obſerved. I have before hinted, that their extent and ſituation ſhould alſo be remarked, and the places moſt worthy of regard in the ſeveral diſtricts fixed on the memory. But this particular information ſhould not be conſidered as abſolutely neceſſary in all caſes; for general purpoſes, a general acquaintance will commonly ſuffice; and it is only in order to a perfect acquaintance with every thing relating to them, and where the moſt circumſtantial knowledge of the geography of any particular county is adviſable, that this method is neceſſary to be recommended.

Another thing remarkable in a good map of a county, is an accurate repreſentation of mountains, foreſts, parks, chaſes, and other noted places it includes. From hence, and by an accurate attention to the number, ſize, and courſe of the rivers it contains, a general idea may be formed of the face of a county. To this knowledge ſhould be added a due attention to ſome comprehenſive deſcription of ſuch county, the careful peruſal of which, and a regular application to the map of ſuch county reſpectively, will enable any perſon of tolerable capacity to join in almoſt any converſation relating to the general ſtate of ſuch county. What would render theſe particular objects the more ſtriking, is to diſtinguiſh each of them by ſome ſlight colour peculiar to itſelf, and characteriſtic of its nature, if neceſſary; but this is too frequently neglected in the beſt maps, and ſuch as are ſold in the ſhops as coloured. Hence it would be adviſeable

able for perſons of ingenuity to buy their maps plain, and to colour them according to the directions which will be hereafter given; the ſingular advantage of which improvement muſt be obvious, eſpecially if done as already intimated.

In theſe we may obſerve, that a due attention to particular cities and towns, or other places of note or eminence, may be included. To diſtinguiſh theſe by ſome characteriſtic colour, muſt be highly proper and adviſable; but this matter is very ſeldom attended to. They ſtrike the eye at the firſt glance, and the beauty of maps, as well as their utility, is greatly improved by a proper attention to ſuch minutiæ.

LESSON VI.

Having ſufficiently diſcuſſed the nature of maps on a ſmaller ſcale, we may naturally proceed to ſuch as are larger and more comprehenſive. What has been ſaid of the different counties or diviſions in the ſame ſtate or kingdom, will equally apply to ſuch as include ſeveral ſtates or kingdoms. By attending to the ſituation and extent of each, the capital or principal cities of the ſeveral kingdoms or ſtates, with their direction to, and diſtance from each other, every part of the knowledge requiſite to a general acquaintance with them may be readily obtained. And as the latitude and longitude are always expreſſed in the margin of ſuch larger maps, the obſervations already made will be alſo eſſentially ſerviceable in this ſtage of our enquiries.

One thing more muſt be obſerved of ſuch large maps as include ſeveral provinces or kingdoms, which is ſometimes alſo to be ſeen in ſmaller maps. The ſeveral lakes and ſeas, gulphs, and other remarkable appearances, whether wholly inland, and in the interior parts of a country, or adjoining to the ſea, ſhould be carefully noted, and the particular provinces or ſtates in which ſuch appearances are found, ſhould be attentively conſidered. Thus, by a due obſervation of the ſeveral circumſtances found in maps, and a careful attention to ſuch remarks as have here been laid down, it is ſcarce poſſible for any perſon of common ingenuity or applicaquaintance with that which preſented at a diſtance the moſt unfriendly and forbidding aſpect. The ſame method, if regularly purſued through each diviſion, province, or diſtrict, will readily direct to the uſe of the moſt complicated and extenſive map, in this diſſected ſtate, and give to each city, town, or village, its proper place and ſituation in the general deſcription.

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By ſuch an orderly and regular progreſſion from country to country, and from kingdom to kingdom, it cannot be doubted that the reſult of our labour and enquiry muſt be ſuch, as amply to reward our trouble and attention to matters of ſuch great importance to ſcience. And in this manner it will not be difficult to underſtand the maps of the four general quarters of the world, Europe, Aſia, Africa, and America. Theſe being properly and carefully attended to, we may proceed to a knowledge of maps of the world, as commonly delineated on two hemiſpheres, or apparent circles, (already alluded to in Leſſon II.) though in reality they are intended to repreſent two ſemi-globes. Thus the ſituation of each of theſe general quarters appears at once to the eye; and the comparative extent and ſize of them, with reſpect to each other, becomes plain and obvious. Theſe will greatly expedite the knowledge of Geography as a ſcience, to which I ſhould now proceed; but becauſe this is ſo largely treated in Mr. Fenning's Uſe of the Globes, and in the laſt edition of his *Young Man's Book of Knowledge*, juſt printed, as well as in the Rev. Mr. Turner's *New and Eaſy Introduction to Univerſal Geography*, I ſhall proceed to treat, in the next place, of Navigation.

Of NAVIGATION.

IT is unneceſſary, and indeed impracticable, within our narrow limits, to give a hiſtory of Navigation, or the degrees of perfection it arrived to in different ages from its firſt rude ſtate. As it is known to conſiſt in the art or management of conducting a ſhip from one port to another, we ſhall conſider it as depending on Geometry and Trigonometry, and but briefly touch upon ſome uſeful matters relating to it.

It has been obſerved, under our Geographical leſſons, that the miles contained in a degree of longitude are variable, and diminiſh gradually in number as the diſtance from the equator or the increaſe in latitude. The young ſtudent is deſired to remember this, and from hence to infer the utility of ſuch notes as will be annexed to the examples hereafter given. We ſhall here preſent him with a table of geographical miles contained in a degree of longitude on each parallel or degree of latitude, which, though commonly given under geography, may be applied to the purpoſes of Navigation with great advantage, and has been purpoſely corrected for this work.

A TABLE, *ſhewing the Number of Miles and hundredth Parts of a Mile contained in a Degree of Longitude on each Parallel of Latitude from the Equator to the Pole.*

Deg. of Lat.	Miles.	Parts.	Deg. of Lat.	Miles.	Parts.	Deg. of Lat.	Miles.	Parts.
1	59	99	31	51	47	61	29	08
2	59	96	32	50	93	62	28	15
3	59	91	33	50	37	63	27	22
4	59	85	34	49	79	64	26	28
5	59	77	35	49	20	65	25	33
6	59	67	36	48	59	66	24	38
7	59	56	37	47	96	67	23	42
8	59	43	38	47	32	68	22	45
9	59	28	39	46	67	69	21	48
10	59	11	40	46	00	70	20	50
11	58	92	41	45	32	71	19	52
12	58	71	42	44	62	72	18	53
13	58	49	43	43	91	73	17	54
14	58	25	44	43	19	74	16	54
15	57	99	45	42	45	75	15	54
16	57	71	46	41	70	76	14	54
17	57	41	47	40	94	77	13	53
18	57	09	48	40	17	78	12	52
19	56	75	49	39	39	79	11	50
20	56	40	50	38	60	80	10	48
21	56	03	51	37	80	81	9	45
22	55	65	52	36	98	82	8	42
23	55	25	53	36	15	83	7	38
24	54	83	54	35	31	84	6	34
25	54	40	55	34	45	85	5	29
26	53	95	56	33	58	86	4	24
27	53	49	57	32	70	87	3	18
28	53	01	58	31	81	88	2	12
29	52	51	59	30	91	89	1	06
30	52	00	60	30	00	90	0	00

As the three principal branches of Navigation, Plain Sailing, Mercator's Sailing, and Circular Sailing, are treated of and explained in the Book of Knowledge, I ſhall briefly ſtate the method of Middle Latitude Sailing, in a way not generally noticed, for which the preceding table has been given.

Of Sailing by Middle Latitude.

By Middle Latitude Sailing we underſtand the degree, &c. of latitude exactly in the Middle between the latitude failed from and the place the ſhip is now in. The uſe to be made of this is, to find out the difference of longitude by the departure, which, though not ſtrictly true, becauſe the miles contained in a degree of longitude on the different parallels do not diminiſh equally, is generally near enough for practice.

Problem I. If a ſhip ſails towards the ſouth-weſt, upon a courſe which makes an angle with the meridian of 30 degrees, to the diſtance of 100 miles, what is her difference of latitude and longitude, and what latitude is ſhe now in, ſuppoſing her to ſet out from 45 deg. 30 min.

1. For the difference of latitude, ſay, as radius or the S. of 90 deg. is to the diſtance ſailed, 100 miles, ſo is the C. S. of the angle of the courſe, 30 deg. to the difference of latitude.

2. Then for the difference of longitude, ſay firſt for the departure, as radius is to the diſtance ſailed, ſo is the S. of the angle of the courſe to the departure.

3. Take half the difference of latitude, and ſubtract it from the latitude given by the queſtion, and it will leave the middle latitude. Find by the above table how many miles are contained in a degree of longitude for parallel of latitude, by which divide the departure, and the quotient will give the degrees, &c. of longitude, to be added or ſubtracted as occaſion requires.

Note 1. By the above proportions, the difference of latitude will be 86.60, or 86 min. 36 ſec. and conſequently the latitude the ſhip is now in muſt be 44 deg. and above 3 min. the departure is 50, and the miles contained in a degree on the parallel of 44 deg. 47 min. or the middle latitude are 42.59, and the difference of longitude will therefore be 70.4. If then the longitude from London before was 5 deg. 25 min. weſt, the difference of longitude added, as the ſhip ſailed towards the weſt, will make the longitude the ſhip is now in to be 6 deg. 35 min.; but if the ſhip had been in eaſt longitude, the difference of longitude muſt have been ſubtracted.

Note 2. The number of miles contained in a degree on any parallel of middle latitude is found by this proportion, as radius or the S. of 90 deg. is to the C. S. of middle latitude, ſo is the the S. of half a deg. or 30 min. to the number of miles contained in half a degree of longitude on that parallel, which double for the miles in a degree; then for the whole difference of longitude, whether greater or leſs than a degree, ſay, by the Rule of Three, as the laſt found number is to 60, ſo is the departure to the whole difference of longitude.

PROBLEM II. If the ſame ſhip, when in latitude 44 deg. 3 min. north, and 6 deg. 35 min. weſt longitude, ſails 100 miles more on a courſe betwixt the ſouth and eaſt, which makes an angle with the meridian of 15 degrees, what latitude and longitude will ſhe then be in?

For the Difference of Latitude.

As radius is to the diſtance ſailed, ſo is the C. S. of the angle of the courſe to the difference of latitude, which in this caſe is 96.59, or 97 minutes nearly, which ſubtracted from 44 deg. 3 min. will leave 42 deg. 26 min. for the latitude the ſhip is now in.

For the Departure and Difference of Longitude.

As radius is to the diſtance, ſo is the S. of the angle of the courſe to the departure, 25.87 miles. Then having found the middle latitude, as directed under the laſt Problem, and the miles contained in a degree of longitude on that parallel, find the whole difference of longitude, as before, which will be 35.5 min.; and as the ſhip ſailed towards the eaſt, ſubtract it from 6 deg. 35 min. and the remainder 6 deg. will give the longitude of the ſhip.

Note, If the ſhip had been in eaſt longitude, the difference of longitude muſt have been added. It is an infallible rule to add eaſt to eaſt and weſt to weſt, but to ſubtract eaſt from weſt and weſt from eaſt.

Theſe two examples are ſufficient to ſhew the nature of Navigation. Before a perſon is qualified to make an obſervation, and thereby to correct his latitude and longitude by calculation from the log, which is often neceſſary on account of currents, the ſhip's lee way, and other cauſes known to ſeamen, which make ſuch calculations vary from truth, it will be neceſſary to be more fully acquainted with theſe matters by regular inſtruction or ſtudy than our narrow limits will permit. The Editor is preparing for the preſs a ſmall work of this nature, which will comprehend in a very ſmall compaſs all the knowledge generally neceſſary and uſeful for the practical navigator. It is neceſſary now to proceed to Aſtronomy.

Of ASTRONOMY.

LEAVING the confined track purſued by the writers of former Companions, I ſhall neither limit my obſervations on this ſublime ſcience to a few calculations only of ſome uſeful matters, or merely to give a theory of the planetary ſyſtem. I propoſe, in a ſhort method, to treat of both, as equally neceſſary to direct our ſtudent into the knowledge of creation's wonders; to ſtartle and amaze him, but not to leave him in Egyptian darkneſs; to lead him by the hand to the contemplation of the ſtarry heavens, and to expand and enlarge the faculties of his mind to perceive the beauty and harmony of the Almighty's ſtupendous works.

The Solar Syſtem, or that which regards the Sun as its center, conſiſts of ſeven planets, each receiving their light and heat from the Sun; ſome of theſe being attended by one or more moons, which regard their reſpective planet as a center, and revolve round the Sun alſo with it. Each of theſe ſhall be conſidered briefly in their order, firſt premiſing a few words reſpecting the Sun, and proceeding from the planet neareſt to him to that which is moſt remote; and obſerving that every planet moves in an orbit round the Sun nearly, though not exactly, circular, ſubject to this invariable law, that the mean diſtance is in proportion as the cube of ſuch diſtance to the ſquare of its time in revolving round the Sun.

The SUN is now almoſt univerſally conſidered as a very large body of fire, which gives light and heat to all the planets, with their ſatellites, in the ſolar ſyſtem; and for this reaſon it is placed in the center, having no other motion than a periodical one round its own axis in about 25 days and a quarter. Its diameter by calculation * is 970967 miles, its circumference 3050390 miles, its ſuperfices 2961828027130 ſquare miles, and its magnitude or bulk will be above 4793062123336 millions, or more than 479306 millions of millions of ſolid miles, a number almoſt ſurpaſſing belief, did not the laws and proportions of diſtant bodies confirm it. It needs only to be remarked farther, that Mercury is the planet neareſt the Sun, then Venus, after that the Earth with the Moon, after that Mars, then Jupiter, then Saturn, and laſt of all, for the honour of the preſent age and the preſent reigning prince in this kingdom, the Georgium Sidus has been diſcovered, at a

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* As this calculation may be conſidered by ſome as too great, a method is obvious for correcting it. Having nicely meaſured the Sun's apparent diameter in minutes, &c. of a degree, by a good micrometer (an inſtrument peculiarly calculated for taking the diameters of ſtars or planets) the diameter in miles is eaſily found by this proportion; as the horizontal parallax of the ſtar or planet, in its loweſt denomination, is to the Earth's diameter in miles, ſo is the apparent ſemi-diameter of ſuch ſtar or planet, to its diameter in miles. This proportion, when the Sun's parallax is taken at 8″ 39‴, and his ſemi-diameter at 16′ 13″, will make the Sun's diameter to be 896509 miles; and this is much more than has been generally ſuppoſed.

diſtance very remote, of which more will be ſaid preſently. I ſhall begin with thoſe neareſt to the Sun, as propoſed.

At the diſtance of 37 millions of miles nearly from the Sun we find the orbit of MERCURY. He moves round the Sun in the ſpace of 87 days 23 hours and 16 minutes, his diameter being about 3000 miles, his circumference 9425, and his magnitude more than 14137 millions of miles. His greateſt elongation from the Sun never appears to us to be much more than 27°; hence he is ſeldom ſeen by the naked eye, but whenever he is viſible, appears of a very bright red colour. His light from the Sun is above ſix times ſtronger than ours at the Earth, and conſequently the heat proportionally intenſe.

VENUS is ſituate at a diſtance from the Sun, though not ſo near as Mercury, yet nearer than the Earth; and the light and heat ſhe receives from him are nearly double to that received upon our Earth. She appears of a yellowiſh white, and moves round the Sun in her orbit in 224 days 16 hours 49 minutes, at a mean diſtance of nearly 69 millions of miles. Her diameter is 9330 miles, her circumference 29311 miles, and her magnitude in ſolid miles about 425250 millions of miles. Some aſtronomers have ſuppoſed her to have a ſatellite, or attendant moon moving round her, at the diſtance of three-fifths of her diameter; but its form being irregular, and diameter not one fourth of that of its primary, and but ill defined, made further notice of it unneceſſary. The greateſt elongation of Venus from the Sun, as ſhe appears from the Earth, is about 48 degrees.

The EARTH, being the planet which we inhabit, comes next in our way, at the diſtance of 95 millions 173 thouſand miles from the Sun. Its diameter is 7970 miles, its circumference 25038, its ſuperfices in ſquare miles is above 199 millions and a half, and its magnitude or bulk in cubic miles ſomewhat more than 265 thouſand and 78 millions. Its periodical time is 365 days 5 hours 48 minutes and 55 ſeconds, being the true ſolar year, or the time in which it moves round the Sun in its orbit. Beſides this annual and progreſſive motion, its daily rotation upon its axis from weſt to eaſt in 23 hours and about 56 minutes occaſions the returns of day and night every 24 hours*; which 24 hours is compounded of the time of the rotation juſt mentioned, and of the daily addition of nearly 4 minutes, being the daily progreſſion of the Earth in her orbit.

The Moon, which is the Earth's ſatellite or attendant, and accompanies it in its progreſs round the Sun, is diſtant from the Earth about 240000 miles. Her diameter is computed to be about 2175 miles, her circumferance 6833, and her magnitude or bulk 5,387,393,437 ſolid miles. She moves round her axis in 27 days 7 hours 43 minutes, and in the ſame time round the Earth; but becauſe the Earth has gradually advanced about 59′ 8″ in a day during this period, it will take up 29 days 12 hours 44 minutes and about 3 ſeconds, before ſhe comes into the ſame ſituation with reſpect both to the Earth and Sun, for ſo much is the mean time betwixt one new Moon and another. The Moon at different times during this revolution appears differently ſhaped, being ſometimes gibbous or horned, and gradually increaſing from her change to her full, when ſhe appears to have a large broad face, being then oppoſite to the Sun, and the Earth at that time being betwixt her and the Sun; from thence ſhe gradually declines as ſhe moves more to the eaſtward, till ſhe comes betwixt the Earth and the Sun, when ſhe does not appear at all. If the moon moved in the ſame direction with the Earth, the Sun would be eclipſed by her every new Moon, and the inhabitants of our Earth would be deprived of his light; and the Moon in like manner would be eclipſed by the Earth at every full Moon, as then being betwixt the Sun and her; but theſe appearances or phenomena, as they are called, are not ſo frequent, becauſe the Moon's orbit makes an angle of about 5° with the Earth's orbit, and no eclipſe can happen but when ſhe is ſo near the interſection or croſſing thoſe orbits, that the two ſemi-diameters are leſs than the diſtance of the orbits. But I muſt refer the reader to Mr. Turner's *View of the Heavens* for a further account, and to the *Heavens ſurveyed*, by the ſame author; in which latter work, a very ingenious method of calculating the planets places, and other uſeful knowledge, may be ſound, of great importance to the young ſtudent.

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* The Earth's motion in her orbit not being the ſame with that of her rotation upon her axis, but inclined at an angle of 23° and about 28′, ſometimes from it and ſometimes towards it (a change which is the neceſſary conſequence of its globular form, and not from any real change in its motion), the variation in the duration of days and nights is from hence obvious, and their difference in the ſeveral parts of our globe naturally accounted for. By this motion, the Earth from Midſummer to Chriſtmas, or from the ſummer to the winter ſolſtice, as they are called, will ſeem gradually to ſhun the Sun, whence it will as gradually return, and from Chriſtmas to Midſummer ſeem to approach it. For although the day and night, taken together, are always equal to 24 hours, no two days together are exactly of the ſame length.

The planet MARS, at the diſtance of more than 145 millions of miles, revolves round the Sun in 686 days 23 hours 27 minutes. His diameter is 5,400 miles, circumference near 17 thouſand, his ſuperficies ſomewhat more than 91 millions and a half, and his magnitude in ſolid miles nearly 82448 millions. He always appears of a ruddy colour, ſomewhat muddy and troubled, being encompaſſed with a very cloudy atmoſphere.

The planet JUPITER is the next in our way. His diameter is 94000 Engliſh miles, circumference 295310, ſuperficies in ſquare miles nearly 27760 millions, and his bulk or magnitude in cubic or ſolid miles almoſt 435 millions of millions of miles. His orbit is nearly 495 millions diſtant from the Sun, and he performs his revolution in 4332 days 12 hours 20 minutes, or almoſt 12 years. He appears of a ſplendid and beautiful white colour. Jupiter is conſtantly attended by four ſatellites or moons, which regard him as a center, and move round the Sun with him. That neareſt his body moves round its orbit in 1 day 18 hours 28 minutes and 36 ſeconds, at the diſtance of about 5.6 ſemi-diameters of that planet's body, or 263200 miles from the center, and is ſecond in magnitude of thoſe four. The next revolves in 3 days 13 hours 17 minutes and 54 ſeconds, at the diſtance of 9 ſemi-diameters of Jupiter's body, or 423000 miles, and is third in magnitude. The third revolves in 7 days 3 hours 59 minutes and 36 ſeconds, and is the largeſt of the four; its diſtance is 14.5 ſemi-diameters, or 681500 miles. The fourth at the diſtance of 25.25 ſemi-diameters, or 1186750 miles, performs its revolution in 16 days 18 hours 5 minutes and 12 ſeconds, and is leaſt of all the ſatellites. But theſe moons do not always appear according to their diſtance; for the remoteſt will often ſeem to be the neareſt to a ſpectator on the Earth, and that which is really the neareſt to be fartheſt remote. They ſometimes appear by a good teleſcope to paſs over the face of Jupiter, when they paſs between the Earth and the planet, and at other times are eclipſed by him when they paſs behind him. But of theſe enough has been ſaid for the information of the young ſtudent in Aſtronomy, and more may be found in the works already referred to under the Moon.

Saturn has, till lately, been conſidered as the higheſt planet, at the diſtance of 908 millions of miles nearly from the center of the ſyſtem. His diameter is 78000 miles, circumference 245045, ſuperficies in ſquare miles nearly amounts to 19113 millions and a half, and its magnitude in cubical miles ſomewhat more than 248 millions of millions and 475427 millions of miles. The time of his revolution round the Sun is 10759 days 6 hours 36 minutes, being almoſt 29 years and a half. His colour is that of a dim lead, and is eaſily known, his face being always round and full. Saturn is attended by five ſatellites or moons, which regard him as a center, and move round the Sun with him. That which is neareſt his body moves round him in 1 day 21 hours 18 minutes and 26 ſeconds, at the diſtance of 4¼ ſemi-diameters from his center, or 165750 miles. The next revolves in 2 days 17 hours

41 minutes and 10 ſeconds, at the diſtance of 5¾ ſemi-diameters from his center, or 224250 miles. The third moves round the body of Saturn at the diſtance of 8 ſemi-diameters, or 312000 miles, in 4 days 12 hours 25 minutes and 10 ſeconds. The fourth at the diſtance of 20 ſemi-diameters, or 780000 miles, revolves about him in the ſpace of 15 days 22 hours 41 minutes and 28 ſeconds. The fifth and fartheſt diſtant is computed to be 59 ſemi-diameters, or 2301000 miles, and performs its revolution round him in 79 days 7 hours and 46 minutes. Saturn will frequently eclipſe theſe moons, and be eclipſed by them; or they will appear as ſpots on his face when they paſs betwixt us and the planet, and be obſcured by the planet when they paſs beyond him. As theſe only are diſcernible by a teleſcope, no more need be ſaid of them in this place.

We now come to the GEORGIUM SIDUS, or New Planet, which was diſocvered by Mr. Herſchel, the Aſtronomer Royal at Windſor, in 1781. The ſubſtance of that diſcovery was communicated to the public nearly in the following words: "On the 13th of "March 1781, between the hours of ten and twelve "at night, as Mr. Herſchel, the Aſtronomer Royal "at Windſor, was attempting to diſcover the parallax of the ſtars, by means of double, triple, and "quadruple fixed ſtars, he diſcovered a *new planet*, "belonging to our ſyſtem, as he was examining the "ſmall ſtars near the feet of Gemini, which he named "GEORGIUM SIDUS, in honour of our preſent "Sovereign. It is ſeldom to be ſeen very plainly by "the naked eye. Is is nearly the colour of Jupiter, "or ſomewhat paler and more faint, and its apparent "diameter about 4 ſeconds. By the calculation of M. "de la Lande we are told, that his diſtance from the Sun "is 19 times farther than the Earth is, and its diameter "4½ that of the Earth." I ſhall ſhew the method of deducing from theſe data as many of its properties as poſſible.

Note, That in order to diſtinguiſh the ſeveral parts of the heavens from each other, and conſequently to know the places of the planets and fixed ſtars, the ancient aſtronomers divided the whole into 12 ſigns, each of 30°, and by the different poſitions of the ſtars in and near the ecliptic, deviſed thoſe imaginary figures, which have been ſince retained, the better to diſcover their ſituation. The firſt was called *Aries*, or the *Ram*; next *Taurus*, or the *Bull*; then *Gemini*, or the *Twins*; *Cancer*, or the *Crab*; *Leo*, or the *Lion*; *Virgo*, or the *Virgin*; and when the Sun ſeems to be in any of theſe ſigns, it is ſummer in our northern latitudes: the other ſix are *Libra*, or the *Balance*; *Scorpio*, or the *Scorpion*; *Sagittary*, or the *Archer*; *Capricorn*, or the *horned Goat*; *Aquarius*, or the *Water-bearer*; *Piſces*, or the *Fiſhes*; and when the Sun appears to be in any of them, we have winter.

Example. The apparent diameter of a planet being given, with its diſtance from the Sun in diameters or diſtances of any other known planet, and the diameter of ſuch planet alſo given in diameters or other properties of the known planet, to find the diameter, circumference, ſuperficies, and magnitude of ſuch planet, with its diſtance from the Sun, the time of its revolution, and daily mean motion in the ecliptic, and alſo its parallax, with the other repuiſites; as, for inſtance, in thoſe given above for the Georgium Sidus.

Firſt, Multiply the Earth's diameter by 4.5, for the diameter of the planet, which is 35865 miles, whence its circumference is 112673, its ſuperficies in ſquare miles 4041034504, and its magnitude in ſolid miles 24155283745628. Then for the diſtance, multiply the Earth's diſtance from the Sun by 19, and the product will be 1808 millions 287 thouſand miles for the diſtance of the planet, which doubled gives the diameter of its orbit, and the circumference accordingly becomes 11361 millions 828878 miles.

Secondly, For the time of its revolution in its orbit round the Sun, ſay, by the Rule of Three, as the cube of the Earth's diſtance from the Sun, is to the ſquare of the time in ſeconds of its revolution, ſo is the cube of the planet's diſtance from the Sun, to the ſquare of the time in ſeconds of its revolution; the ſquare root of which being extracted, gives 2613 million 556540 ſeconds; reduce this into days, and the time will be 30249 days 11 hours 55 minutes and 40 ſeconds, equal to[*] 82 years 298 days 23 hours 55 minutes and 40 ſeconds, allowing 12 hours for the two odd years from leap-year. Its daily mean motion in the ecliptic will conſequently be $42''$ $50'''$ and $37''''$, and its mean annual motion $4^{\circ}\ 20'\ 48''\ 39'''\ 24''''$.

Note, That this uſe of the Square and Cube Roots jointly was referred to at the end of the uſes of the Cube-Root, in *p.* 216.

Laſtly, For its parallactic angle, or the angle of its horizontal or greateſt parallax, ſay, by the Rule of Three Inverſe, as the Earth's ſemi-diameter is to the planet's apparent diameter at the Earth, ſo is the planet's ſemi-diameter to the parallactic angle, equal in this caſe to $\frac{8}{9}$ of a ſecond.

Note, Theſe ſeveral dimenſions are deduced, on a ſuppoſition that the planet, at the time of obſervation, was at its mean diſtance from the Earth. If it was betwixt the mean diſtance and perihelion diſtance, all its dimenſions, except the parallax, will be larger; if it was any where betwixt the mean and aphelion diſtance, its properties will be ſmaller, except the parallax, which in this caſe will be larger. Whether it revolves upon its axis as the other planets, however probable, is not certain, and conſequently the length of their day muſt remain unknown. The preſent received ſituation of this planet nearly agrees with this idea; its mean motion ſince its diſcovery being about 22°, and the ſmall ſtars near the feet of Gemini being in about 2° of Cancer, the true place at the beginning of the year (1787) being 24° of Cancer, ſhews the conformity of this ſuppoſition with truth, and conſequently proves that the planet was then at or near its mean diſtance from the Sun.

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[*] A modern author, whoſe employment places him in a ſituation the moſt likely to know the reſult of modern obſervations, gives the revolution at 83 years and 130 days, which is about half a year more than the other; but he gives no method of diſcovering, by means of proper data, how to find the period of ſuch revolution, only placing it in a table of the affections of the ſeveral planets as a matter to be taken for granted. When this calculation was made, the author had not ſeen the work alluded to.

Of the fixed Stars.

Having ſaid as much as is neceſſary upon the Planetary Syſtem, I ſhall paſs by thoſe occaſional phenomena called Comets, and proceed to the fixed Stars, ſo called, becauſe they appear at the ſame diſtances from each other, and have an uniform progreſſion in the ecliptic of about 50″. Their number has, by different aſtronomers, been differently repreſented, according to the goodneſs of the inſtruments with which they have been examined. Our limits will not allow us to be particular upon them; ſuffice it to ſay, that ſuch is the vaſt diſtance of theſe ſtars, that the neareſt of them called *Sirius*, or the Great Dog Star, is ſuppoſed to be at leaſt two millions of millions of miles diſtant, and others vaſtly more; and it is probably that each of theſe may be a ſun to other planetary ſyſtems. Inſtead of enlarging, the ſtudent muſt be referred to Mr. Turner's *View of the Heavens,* or *ſhort Syſtem of modern Aſtronomy,* already mentioned. I had intended to annex two tables of the fixed ſtars; firſt, of thoſe which have very high north latitude, and are attendants, as it were, upon the north pole, never ſetting in our hemiſphere; and, ſecondly, of thoſe which do not much exceed 5° of latitude, either north or ſouth, and ſo fall within the compaſs of the Moon's viſible way; but as their uſes will beſt appear in Navigation, it may not improperly be diſpenſed with in this place. Suppoſing the ſtudent to be in poſſeſſion of tables of logarithms, with the logarithm ſines, tangents, and ſecants, one or two uſeful problems may be added before we proceed.

It has been obſerved, in ſpeaking of the Earth's affections and properties, that her motion in her orbit is inclined from the equinoctial in an angle of 23° 28′, which is called her declination; but ſince this declination continually varies, as the Sun appears to recede from it, more or leſs, being greateſt at Midſummer and Chriſtmas, the one in north and the other in ſouth declination, and nothing at all in the Spring and Autumn, I ſhall firſt ſhew the method of finding this.

1. Suppoſe the Sun to be 30 degrees diſtant from the firſt point of Aries, or in 0 degrees of Taurus, and the greateſt declination to be 23° 28′, ſay, as radius, or the ſine of 90°, is to the S. of 30°, the diſtance from Aries, ſo is the S. of the greateſt declination, 23° 28′, to the S. of preſent declination, or 11° 29′ 6″.

Note, That the diſtance muſt always be taken from Aries or Libra, becauſe in thoſe two points the declination is nothing, and muſt never be more than 90°.

2. If the Sun's preſent declination be known, and the latitude of the place, the time of the Sun's riſing and ſetting may be alſo known, and conſequently the aſcenſional difference, or degree of time that the Sun riſes or ſets before or after ſix o'clock. Say, as radius, or S. of 90°, is to the T. of the Sun's declination, (ſuppoſe as already found) 11° 29′ 6″, ſo is the T. of the latitude, or the elevation of the pole 51° 32′ (at London), to the S. C. of an arch; if the declination was north, it is ſemi-nocturnal, but if ſouth, ſemi-diurnal; or the laſt number is the S. of the aſcenſional difference, which, converted into time, (allowing 15° for every hour, 15′ for every minute, &c.) is to be ſubtracted from 6 for the time of the Sun's riſing when the declination is north, but added when it is ſouth. In either caſe, the time of the Sun's riſing is 59 min. 16 ſec. before ſix, and its complement to 12 is the time of ſetting, which doubled gives the length of the day.

Note, As moſt of the common problems may be reſolved at ſight, by the help of my improved Card Dial hereafter given, and proportions for the reſt being given in Mr. Fenning's *Book of Knowledge*, to which the ſtudent muſt be referred; I would wiſh to lead him in the next place to an acquaintance with Dialling, to which I hope he will be glad to accompany me.

Of DIALLING.

THE uſe of Dials is ſo well known, that every one muſt wiſh to know the method of making them; and this is the more adviſable and neceſſary, becauſe very few are qualified for it, even of thoſe who attempt it. Hence it is obſervable, that moſt dials are more or leſs erroneous as the time is diſtant from 12 o'clock, when alone, ſuppoſing them to be truly placed, they point out the true time. But there is too much reaſon to ſuppoſe, that the mechanic in erecting them may be as ignorant as the delineator; from whence the errors may be almoſt incredible, though the expence probably is as great, or greater, than would have procured a good dial, drawn correctly and judiciouſly, and erected according to rules of art.

A polar dial is what we have no occaſion for. An equinoctial dial in like manner can only be uſeful to thoſe who live on the equator, or very near it, and therefore it is unneceſſary to thoſe for whoſe advantage this work is intended. An horizontal dial is moſt common, and generally moſt uſeful, which I ſhall here preſent, with the method of making it in any latitude.

Of an Horizontal Dial.

Where this dial can be ſo placed as to receive the Sun's direct rays, from his riſing to his ſetting, there will be no need to uſe any other. This is to be placed flat or horizontal (whence its name) on an upright ſtrong poſt or pillar of wood or ſtone, as every one knows. The proportion for finding the arches or diſtance from the XII o'clock line of the hours, half hours, and quarters, is as follows, accounting 15° to every hour, 7° 30′ to half an hour, and 3° 45′ to every quarter; as radius or S. of 90°, is to the S. of the latitude of the place, ſo is the T. of the ∠ of the time from noon, to the T. of an arch, the chord of which being applied to the outer circle from XII, ſhews the point through which from the center to draw the hour line, half hour, or quarter reſpectively.

As our limits will not allow us to inſert a table of logarithms, with the logarithm ſines and tangents, for the uſe of thoſe who may not have them, the following table, corrected from the errors of other authors by calculation, is inſerted, one or other of which latitudes will pretty well ſerve for all places in England, Scotland, or Ireland.

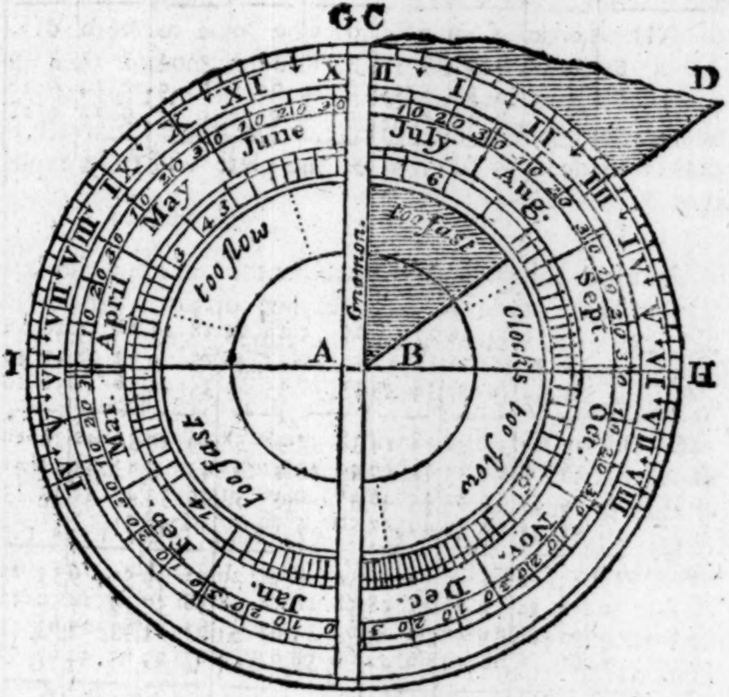
A TABLE

A TABLE *of* DISTANCES *to be taken from the Chords, for all the Hours, Half Hours, and Quarters, in Horizontal Dials, from Lat.* 50° *to Lat.* 57° *incluſive.*

Hours and their Parts.		Lat 50.		Lat. 51.		Lat. 52		Lat. 53.		Lat. 54		Lat. 55.		Lat. 56.		Lat. 57.	
		D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D	M	D.	M.
XII		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	3	2	52	2	55	2	57	3	0	3	2	3	4	3	7	3	9
2	2	5	45	5	50	5	55	6	0	6	5	6	9	6	14	6	18
3	1	8	40	8	47	8	55	9	2	9	8	9	15	9	22	9	28
I	XI	11	36	11	46	11	55	12	5	12	14	12	23	12	31	12	40
1	3	14	35	14	47	14	59	15	10	15	21	15	32	15	43	15	53
2	2	17	36	17	51	18	5	18	18	18	32	18	45	18	57	19	10
3	1	20	42	20	58	21	14	21	30	21	45	22	0	22	14	22	28
II	X	23	51	24	10	24	28	24	45	25	2	25	19	25	35	25	50
1	3	27	6	27	26	27	46	28	5	28	24	28	42	28	59	29	16
2	2	30	27	30	48	31	10	31	30	31	50	32	9	32	28	32	46
3	1	33	54	34	17	34	39	35	0	35	21	35	42	36	1	36	20
III	IX	37	27	37	51	38	14	38	37	38	58	39	19	39	40	39	59
1	3	41	8	41	33	41	56	42	19	42	42	43	3	43	23	43	47
2	2	44	57	45	22	45	46	46	9	46	31	46	52	47	13	47	33
3	1	48	54	49	19	49	42	50	5	50	27	50	48	51	8	51	27
IV	VIII	53	0	53	23	53	46	54	8	54	29	54	49	55	9	55	27
1	3	57	14	57	36	57	58	58	18	58	38	58	57	59	15	59	33
2	2	61	36	61	57	62	16	62	35	62	53	63	11	63	27	63	43
3	1	66	6	66	24	66	42	66	58	67	14	67	29	67	44	67	58
V	VII	70	43	70	59	71	13	71	27	71	41	71	53	72	5	72	17
1	3	75	27	75	39	75	50	76	1	76	11	76	21	76	31	76	39
2	2	80	15	80	23	80	31	80	38	80	45	80	52	80	59	81	5
3	1	85	7	85	11	85	15	85	19	85	22	85	25	85	29	85	32
VI		90	0	90	0	90	0	90	0	90	0	90	0	90	0	90	0

This Table is very eaſy; for having drawn the two meridian lines of your dial, and upon the ſeveral centers (as will be ſhewn preſently) deſcribed ſemicircles, if you wiſh to take off, for example, the chord of IX o'clock in lat. 51°, the table will ſhew you that it is 37° 51′ to be taken from a line of chords made from the ſame radius.

If you wiſh to be more exact in intermediate latitudes, ſuppoſe for London, which is 51° 32′ north latitude, uſe this proportion; as the difference of the two neareſt latitudes, 60′, is to the whole difference of their chords, in this caſe 24′, ſo is 32′, to 13′ nearly. If this be added to 37° 51′, it will make 38° 4′ for the arch of IX o'clock in the latitude of London.



Having drawn the horizontal line VI VI, croſs it at right angles by raiſing a perpendicular, which ſhall repreſent the XII o'clock line; on the middle of which, as a center, draw a ſemicircle. The thickneſs of the ſtile is in the next place to be conſidered, which muſt be allowed for in all caſes of dialling; and in this caſe is done by drawing another meridian line parallel to the other, and on the center in the VI o'clock line another ſemicircle, the diſtance from the former center being exactly equal to the thickneſs of the ſtile or gnomon. This ſhould be particularly attended to, though commonly neglected. Then having found the arches of the reſpective hours, half hours, and quarters, either by the rule or the foregoing table, lay a ruler to the centers reſpectively on each ſide and draw the lines through the circumference of the outermoſt circle for ſuch hours, half hours, and quarters, as in the figure. It muſt alſo be noted, that the diſtances from VI to V, and from V to IV, are the ſame as from VI to VII, and from VII to VIII; and ſo the diſtances from XII to I, and from I to II, are the ſame as from XII to XI, and from XI to X. The ſtile or gnomon then muſt ſtand upright, and make an angle with the dial plate or horizon equal to the latitude of the place for which the dial is made.——A view of the plate will fully explain it.

Another thing highly expedient in a good horizontal dial is the equation or difference of time betwixt the beſt clocks or watches, and the time given by the Sun's rays upon a dial. This is ocaſioned by an irregularity in the Earth's motion, which produces this apparent variation in the Sun, whilſt good watches and clocks meaſure true time. Hence it is that they only agree exactly on four days in the year, April 15, June 17, Aug. 31, and Dec. 24. On four other days their difference is greateſt, viz. Feb. 11, when the time given by the Sun is 14′ 53″ later than that given by good clocks and watches; May 15, when the Sun's time is 4′ 7″ ſooner than that of clocks; July 26, when it is 6′ 3″ later than clocks; and Nov. 2, when the Sun is 16′ 12″ faſter than that of good clocks and watches. Remember then, that as this variation is natural, a good clock or watch ſhould not be altered, if the difference does not exceed that given againſt the reſpective days; for no good dial ſhould be without the equation of time in one circle, placed againſt its reſpective ſeaſons of the year in another, a matter of much importance in the regulation of a clock or watch.

Perhaps it may be expected that the method of fixing the dial ſhould be ſhewn, ſo as to ſtand exactly north and ſouth at 12 o'clock; for no one has occaſion to be told that it ſhould be placed level, on the top of a firm upright poſt or pillar of wood or ſtone, or in ſome ſimilar convenient ſituation. Fix a board or paper on the top of your poſt, with 5 or 6 or more circles ſtruck upon one center, at ſmall diſtances within each other, and draw through the center a line with the fine point of your black-lead pencil, which place as nearly upon a line with the Sun at 12 o'clock, as you can gueſs; a perſon of common judgment cannot err very much. Then place a pin upright in the center, of ſufficient length to ſhade the circles, and mark the place where the head or top of the pin exactly touches any of the circles; this being done in the morning, obſerve where the ſame head touches the ſame circle in the afternoon, and having found the midway with the compaſſes, draw a line through it and the center, which ſhall be the meridian line, on which you muſt place the meridian lines of your dial.

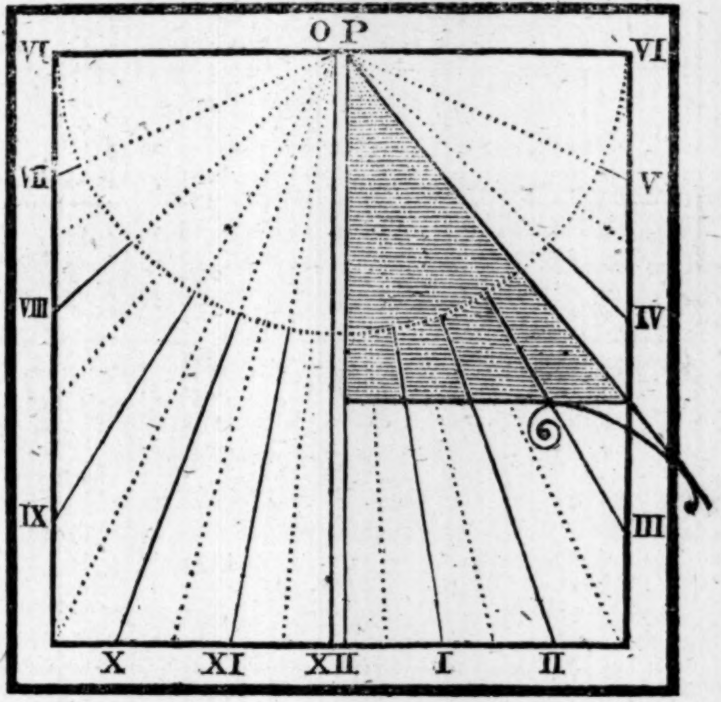
Note, The Sun's declination continually varying will occaſion a ſmall error; but if the obſervations are made as near 12 o'clock as you can, to have a ſenſible alteration of altitude, as it never exceeds a minute in an hour, even at the equinoxes (in March and September), and not a ſecond in an hour at the ſolſtices (in June and December), the conſequence will be inconſiderable. By attention, therefore, it is obvious that no ſenſible error can happen, if the experiment is made any time from the 20th of May to the 20th of July, and eſpecially near the longeſt day; a ſeaſon certainly the moſt proper for ſuch a purpoſe, and the more ſo, as no error can ariſe from any variation in the refraction of the Sun's rays at that ſeaſon, when the declination is as it were ſtationary for two or three days.

It may be of uſe to inſert in this place a table of the latitude of ſome of the principal cities and towns in Great-Britain and Ireland, for the uſe of the young ſtudent who would wiſh to delineate dials for any of thoſe places, or any other place near any of them.

Names of Places.	*Latitude.*		*Names of Places.*	*Latitude.*	
				°	′
ENGLAND.	°	′	Stafford	52	50
St. Alban's	51	45	Truro	50	15
Bedford	52	10	Warwick	52	18
Berwick	55	45	Wincheſter	51	3
Briſtol	51	28	Worceſter	52	14
Buckingham	51	58	York	54	0
Cambridge	52	17			
Canterbury	51	19	**WALES.**		
Carliſle	54	47	Cardiff	51	31
Cheſter	53	10	Cardigan	52	7
Chicheſter	50	50	Carmarthen	51	53
Colcheſter	52	0	Carnarvon	53	10
Dover	51	7	Monmouth	51	50
Derby	52	57	Montgomery	52	33
Dorcheſter	50	41	Pembroke	51	42
Durham	54	55	Radnor	52	19
Exeter	50	44			
Glouceſter	51	50	**SCOTLAND.**		
Guildford	51	12	Aberdeen	57	6
Hereford	52	6	Dumfries	55	4
Hertford	51	42	Edinburgh	55	57
Ipſwich	52	14	Fort William	56	55
London	51	32	Glaſgow	55	52
Lancaſter	54	5	Inverneſs	57	33
Leiceſter	52	40	St. Andrews	56	18
Lincoln	53	16	Wick	58	40
Newcaſtle-upon-Tine	55	3	**IRELAND.**		
Northampton	52	15	Armagh	54	30
Norwich	52	45	Athlone	53	20
Nottingham	52	45	Carrickfergus	54	45
Oakham	52	37	Corke	51	54
Oxford	51	45	Dublin	53	21
Plymouth	50	22	Galloway	53	10
Portſmouth	50	47	Kilkenny	52	30
Reading	51	24	Londonderry	55	1
Saliſbury	51	4	Waterford	52	7
Shrewſbury	52	46	Youghal	51	46

Of Vertical Dials.

What is meant ſimply by a Vertical Dial is one placed againſt the ſouth ſide of a church or other building directly facing the ſouth; for if it turns from the ſouth either towards the eaſt or weſt, it is then called a Declining Vertical Dial, eaſt or weſt reſpectively, but either a Direct Vertical Dial, or only a Vertical Dial, when it faces the ſouth. This dial is made in the ſame manner as a horizontal one; ſave only that, for finding the diſtances of the hour lines, &c. the complement of the latitude muſt be uſed. Here follows a table corrected by calculation for ſeveral latitudes, one or other of which will pretty well ſerve for any place in England, Scotland, or Ireland; and to be more exact for parts of a degree of latitude, take the proportions of ſuch parts or minutes as taught for the table on horizontal dials.



A TABLE

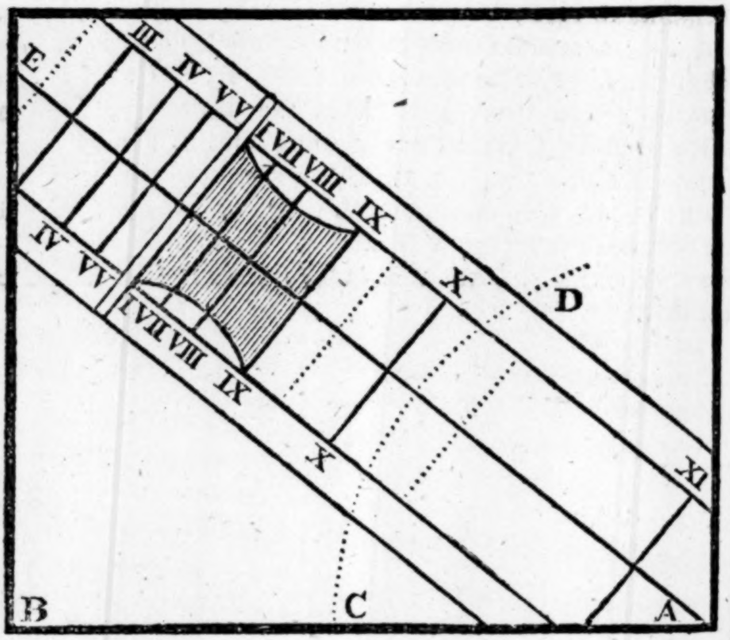
A TABLE *of* DISTANCES *to be taken from the Chords, for all the Hours, Half Hours, and Quarters, in Direct Vertical Dials, from Lat.* 50° *to Lat.* 57° *incluſive.*

Hours and their Parts.		Lat. 50.		Lat. 51.		Lat. 52.		Lat. 53.		Lat. 54		Lat. 55.		Lat. 56.		Lat. 57.	
		D.	M.	D.	M.	D.	M.	D.	M.	D	M	D.	M.	D.	M.	D.	M.
XII		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	3	2	25	2	22	2	19	2	16	2	12	2	9	2	6	2	3
2	2	4	50	4	44	4	38	4	32	4	26	4	19	4	13	4	6
3	1	7	17	7	8	6	59	6	50	6	40	6	31	6	21	6	11
I	XI	9	46	9	34	9	22	9	10	8	57	8	44	8	31	8	18
1	3	12	19	12	4	11	48	11	33	11	17	11	1	10	45	10	28
2	2	14	55	14	37	14	18	14	0	13	41	13	22	13	2	12	43
3	1	17	35	17	14	16	53	16	32	16	10	15	48	15	25	15	2
II	X	20	22	19	58	19	34	19	10	18	45	18	19	17	54	17	27
1	3	23	15	22	48	22	22	21	54	21	27	20	58	20	29	20	0
2	2	26	15	25	47	25	17	24	47	24	17	23	45	23	13	22	41
3	1	29	25	28	54	28	22	27	49	27	16	26	42	26	7	25	32
III	IX	32	44	32	11	31	37	31	2	30	27	29	50	29	13	28	35
1	3	36	14	35	40	35	4	34	28	33	50	33	11	32	31	31	51
2	2	39	57	39	21	38	44	38	6	37	27	36	47	36	5	35	22
3	1	43	53	43	17	42	39	42	1	41	20	40	38	39	56	39	11
IV	VIII	48	4	47	28	46	50	46	11	45	31	44	39	44	5	43	20
1	3	52	30	51	55	51	18	50	40	50	0	49	19	48	35	47	50
2	2	57	12	56	39	56	4	55	28	54	50	54	10	53	28	52	45
3	1	62	10	61	39	61	8	60	34	60	0	59	23	58	44	58	4
V	VII	67	22	66	57	66	29	66	0	65	30	64	58	64	24	63	48
1	3	72	48	72	28	72	6	71	43	71	18	70	53	70	25	69	56
2	2	78	25	78	11	77	56	77	40	77	22	77	4	76	45	76	25
3	1	84	11	84	3	83	55	83	47	83	38	83	29	83	19	83	8
VI		90	0	90	0	90	0	90	0	90	0	90	0	90	0	90	0

It is evident from the nature of the figure here given, that each ſide of the meridian lines O XII and P XII, may be conſidered as a parallelogram; of which O XII is the longeſt ſide, and O VI the ſhorteſt, and by making O VI or P VI, which are equal, a radius, ſweep the dotted arch, on which ſet off the reſpective arches of the ſeveral hours, half hours, and quarters, and draw lines through them from O to VI, VII, VIII, and ſo on to XII, and from P to XII (parallel to O XII), I, II, and ſo on to VI. The height of the ſtile muſt make an ∠ at P equal to the complement of the latitude to 90°, the thickneſs of the ſtile being preſented by O P. The ſame dial turned upſide down will equally ſerve for a wall which faces the north, marking the hours with the complements to XII; but the hours IX, X, XI, XII, I, II, and III, are uſeleſs, as the Sun then ſhines upon the ſouth wall. But as the Sun ſhines from 4 to 8 in the morning, and from 4 to 8 in the afternoon, upon a north wall in ſummer, the centers O and P muſt be in the middle of a ſquare or parallelogram, and the diſtances from VI to IV, and from VI to V, ſet off from VI the contrary way to VII and VIII, alſo on the oppoſite ſide from VI to V and IV, which will complete the dial.

Of an Eaſt Dial.

This dial is made for an eaſt wall, and conſequently is calculated only for morning hours. The ſpecimen here given ſhews the nature of it, and it is thus made: Draw the line A B, and with any convenient diſtance, as A C for radius, ſweep the arch C D, and ſet off the angle of 38° 28′, the complement of the latitude of London from C, and draw the line A E from the angle at A through this point. Then draw the other lines parallel, as in the figure, at convenient diſtances, which croſs at right angles in VI VI; this muſt be done ſo far from E to allow room for the hours of V and IV. The hour of III is not wanting in our latitude, as the Sun does not riſe at London till about 16 minutes before IV on the longeſt day; but in latitude 58° 27′, the Sun on the longeſt day riſes at III,



and in latitude 61° 19′ at half paſt II.* They are not therefore introduced as neceſſary in an eaſt dial at London, or any place having leſs northern latitude; but are inſerted in the plate to ſhew the nature of introducing them where wanted in higher latitudes. The two parallel lines at VI VI are for the thickneſs of the ſtile.

It muſt not be forgot that the height of the ſtile is always equal to the radius of a circle, or the tangent of 45°; thus the tangent of 15° is to be ſet off each way from the VI o'clock line to V and VII, and that of 30° to IV and VIII. Alſo the tangent of 45°, which is the height of the ſtile, will alſo be the diſtance from VI to IX, and conſequently that diſtance is always radius; ſo that the tangent of 60° will extend to X, and that of 75° to XI. The half hours alſo may be ſet off, by taking 7° 30′, and the quarters by 3° 45′, to be added reſpectively to the tangents of the hours; that is, the half hour paſt IX is ſet off by the tangent of 52° 30′, and that of half paſt X by the tangent of 67° 30′, and ſo reſpectively for any other.

In like manner a weſt dial may be made, if the angle of the complement or the latitude is ſet off as at B in the left hand corner, and all the hour lines drawn that way at right angles to it; the complements of the hours to XII muſt alſo be taken, as at equal diſtances from the meridian or XII. This dial ſerves for the afternoon, as the eaſt dial does for the morning.

Of the Portable Pocket Dial.

Many other varieties of dials, if our limits permitted, might be introduced; but theſe are ſufficient for moſt uſeful purpoſes. To others, who have no convenience for fixing a dial, or perhaps may be reſidents of a year, and therefore unwilling to incur an unneceſſary expence, ſuch a ſubſtitute as we have here given muſt be very acceptable; particularly as no other work of the kind contains any thing like it, nor poſſibly can comprehend any plan of ſo uſeful an inſtrument for many years. The exerciſe it will afford to the young ſtudent, aſſiſted by the directions here given, muſt prove at once extremely uſeful and pleaſing.

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* The Sun riſes at or before III on the longeſt day in the moſt northernly of the weſtern iſles of Scotland, the northern counties of that kingdom, and in the Orkneys; at Peterſburg a quarter before III, and at half paſt II at or near Wyburg in the ſouth part of Ruſſian Finland. At Archangel, the Sun riſes more than 20 minutes before II in the morning on the longeſt day.

The plate annexed of this very elegant little dial merits the attention of all our readers, both for its eaſy conſtruction and abundant uſes. We ſhall endeavour to explain them both, in a manner adequate to the moſt common capacity; at leaſt to thoſe who know any thing of the nature of an angle, and can take it in the compaſſes from a ſector, or mark it off on the circular edge of a good protractor or ſemicircle.

The line of months is thus to be laid down. At a convenient diſtance from the margin, as at XII for a center, draw a line for the horizon, and ſet off an angle equal to the complement of the latitude of the place. This (for London) is 38° 28′. Apply the ſemicircle, with its center in XII, and the diameter on the bounding line of the angle, and mark off, each way from the extremity of ſuch diameter, every degree of declination to 23° 28′, the greateſt declination. Draw lines through theſe extreme points from XII, which ſhall be the limits within which the line of months muſt be projected; which line muſt be equally diſtant from the end of the line of the complement of latitude, and at right angles with it. Then to divide the ſaid line, apply the ſemicircle to the ſaid bounding line, with the center in XII, and from an ephemeris, or any good almanack, mark off the degrees and minutes of declination at the end of each month, alſo at every 10 and 20 days of the month, and alſo ſubdiviſions at every five days; through which points lay a ruler from XII, and transfer them to the reſpective places, above or below the line of months, to other lines drawn parallel to the middle line. In this manner may the line of months be completed for any latitude, as may be ſeen in the figure.

The arch of declination, as already obſerved, is ſet off each way from the extreme part of the bounding line, or line of no declination.

The arch of the Sun's meridian altitude is alſo ſet off from the horizon, the limits of which muſt always be equal to the ſum of the greateſt declination added to the complement of latitude.

The arches for finding the Sun's place are thus drawn. Obſerve, as before, what degrees and minutes of declination the Sun has at the entrance of each ſign, which mark on the circular edge of your inſtrument, the diameter being laid on the bounding line of no declination, and the center in XII, which transfer to the middle line of months; in which as centers, in ſuch middle line, with the compaſſes always opened to XII, ſweep the reſpective arches, the ends of which are to be marked with the ſigns accordingly.

The hour lines, for finding the time of the day, are thus drawn. From the point where the line of no declination meets the line of the months, draw an obſcure line parellel to the horizontal line drawn from XII, drawing it full acroſs the arches of the Sun's place; this ſhall be the VI o'Clock line, to which at right angles from the point XII, draw an obſcure line, which ſhall be the radius of a ſemicircle for drawing the other hour lines, half hours, and quarters. With one point of the compaſſes in this VI o'clock line, ſtrike an obſcure ſemicircular arch from XII, or ſo much of it as is neceſſary; divide the ſaid arch from the obſcure part of that VI o'clock line to XII into 90 degrees (as it will always be a quadrant) and at every 15° let down a parallel line for the hours, at 7° 30′ for the half hours, and at 3° 45′ for the quarters. This is done each way from VI, the limiting point on the right hand being determined by the parallel line drawn from the extreme point in the middle line of months.

The arch of altitudes is drawn by making the extreme point juſt mentioned a center; and extending the compaſſes beyond the arches of the Sun's place at pleaſure, ſweep the arches, which graduate by means of a ſector or other inſtrument, as you ſee in the plate.

Laſtly, mark out the gnomon, as is ſeen in the figure, cutting out the top, bottom, and left ſide, when preparing for uſe. Alſo, cut through the middle line of months for a ſilk thread to ſlide through, on which a ſmall bead is to be put, with a plummet at the end.

The dial being thus conſtructed, if you wiſh to know the time of the Sun's riſing and ſetting, move the thread to the day of the month and lay it on its proper parallel; when the hour and parts of an hour of the Sun's riſing will be ſeen in the lower claſs of figures, and of his ſetting in the upper, and by doubling the time of the Sun's ſetting, you have the time of the Sun's being above the horizon.

The thread being put to the day of the month, and laid to the center at XII, the degrees of the Sun's declination, whether north or ſouth, will be cut in its proper arch, and alſo the meridian altitude at the ſame time in the place for which the dial is made.

The Sun's place is alſo known nearly by putting the bead to XII, and ſuffering it to play freely among the arches, till it reaches the extreme ends, which diſcovers the ſign and part of the ſign the Sun is then in; for if the upper line of months gives the time, the ſign is given in the left-hand column, but if the lower, it is had in the right hand column.

The hour of the day is thus known, the thread being firſt moved to the day of the month. Raiſe the gnomon ſo as to caſt a ſhadow when the edge of the right ſide of the dial is turned towards the Sun. Then move the bead to XII, and hold up the dial that it may play freely on the face; and when the ſhade of the upper edge of the gnomon exactly ſtrikes the boundary line at the top of the dial, mark the place of the bead, which, for greater certainty, you may hold with the left thumb. That parallel on which the bead then is will give the hour; if before XII in the lower arch, but if after XII in the upper arch. For inſtance, let us ſuppoſe it was deſired to know the hour in the morning of the 10th of May; having fixed the thread to the day of the month, hold up the dial in your left hand, by turning your right towards the Sun, and the bead and gnomon being diſpoſed as directed, we will ſuppoſe the bead to fall on the dotted parallel next after IX, which will give the time 15 minutes after IX for the hour. Thus you may proceed for any other hour.

N. B. It is beſt to take the hour by this dial before X in the morning, or later than II in the afternoon, if you wiſh to know the time very nearly; for as the diſtances of the hours depend upon the variation of the Sun's altitude, and as that variation is leaſt when he is near the meridian, the diſtances are proportional. But for general purpoſes, the hour may be known ſufficiently near the truth any part of the day.

The altitude of any building, tree, &c. may be obtained in like manner, by means of the arch of altitudes. Then, having moved the thread to the longeſt day, the center upon which the arch of altitudes is ſtruck, let the thread play freely, and at the diſtance of 20, 30, or 40 feet, or more, from the foot of the object, look along the upper boundary line by the top of the gnomon, and obſerve what degree is cut by the thread in that arch. Then look in the table annexed againſt that degree, and under the diſtance from the object is the height above the eye.

Thus, if at the diſtance of 20 feet from the lower end of a May-pole, you look along the bounding line, or the top of the gnomons (cutting out another gnomon, like the firſt, at the upper left-hand corner, for this purpoſe only), and the thread cuts the arch of altitudes at 52°, to find the May-pole's height. Againſt 52°, under 20 at the top, is 25.60 for the height above the eye; and ſuppoſing the eye to be 5 feet from the ground, the height of the May-pole will be 30 feet and little more than a half from the ground.

A TABLE *of* ALTITUDES *included within different Angles at ſeveral Diſtances, to find out the Height of Buildings, Trees, &c.*

Deg.	20	30	40	50	60	70	80
10	3.52	5.29	7.05	8.81	10.58	12.34	14.10
11	3.98	5.83	7.77	9.72	11.66	13.60	15.55
12	4.25	6.37	8.50	10.63	12.75	14.88	17.00
13	4.61	6.92	9.23	11.54	13.85	16.16	18.47
14	4.98	7.48	9.97	12.46	14.96	17.45	19.94
15	5.36	8.04	10.72	13.39	16.07	18.75	21.43
16	5.73	8.60	11.47	14.33	17.20	20.07	22.94
17	6.11	9.17	12.23	15.28	18.34	21.40	24.46
18	6.50	9.75	12.92	16.24	19.49	22.74	25.99
19	6.88	10.33	13.77	17.21	20.66	24.10	27.54
20	7.38	10.92	14.56	18.20	21.84	25.48	29.11
21	7.67	11.51	15.35	19.19	23.03	26.87	30.71
22	8.08	12.12	16.16	20.20	24.24	28.28	32.32
23	8.49	12.73	16.98	21.22	25.47	29.71	33.96
24	8.90	13.35	17.81	22.26	26.71	31.16	35.62
25	9.32	13.99	18.65	23.31	27.98	32.64	37.30
26	9.75	14.63	19.51	24.38	29.26	34.14	39.02
27	10.19	15.28	20.38	25.47	30.57	35.66	40.76
28	10.63	15.95	21.27	26.58	31.90	37.22	42.53
29	11.08	16.63	22.17	27.71	33.26	38.80	44.34
30	11.54	17.32	23.09	28.86	34.64	40.41	46.19
31	12.01	18.02	24.03	30.04	36.05	42.06	48.07
32	12.49	18.74	24.99	31.24	37.49	43.74	49.99
33	12.99	19.48	25.97	32.47	38.96	45.46	51.95
34	13.49	20.23	26.98	33.72	40.47	47.21	53.96
35	14.00	21.00	28.01	35.01	42.01	49.01	56.01
36	14.53	21.79	29.06	36.32	43.59	50.86	58.12
37	15.07	22.60	30.14	37.68	45.21	52.75	60.28
38	15.62	23.44	31.25	39.06	46.87	54.69	62.50
39	16.19	24.29	32.39	40.49	48.58	56.68	64.78
40	16.78	25.17	33.56	41.95	50.34	58.73	67.13
41	17.38	26.08	34.77	43.46	52.15	60.85	69.54
42	18.01	27.01	36.01	45.02	54.02	63.03	72.03
43	18.65	27.97	37.30	46.62	55.95	65.27	74.60
44	19.31	28.97	38.62	48.28	57.94	67.60	77.25
45	20.00	30.00	40.00	50.00	60.00	70.00	80.00
46	20.71	31.06	41.42	51.77	62.13	72.48	82.84
47	21.44	32.17	42.89	53.62	64.34	75.06	85.79
48	22.21	33.32	44.42	55.53	66.63	77.74	88.85
49	23.00	34.51	46.01	57.52	69.02	80.52	92.03
50	23.83	35.75	47.67	59.59	71.50	83.42	95.34
51	24.70	37.04	49.39	61.74	74.09	86.44	98.79
52	25.60	38.40	51.19	63.99	76.79	89.59	102.39
53	26.54	39.81	53.08	66.35	79.62	92.89	106.16
54	27.52	41.29	55.05	68.82	82.58	96.34	110.11

Colours, &c. for Maps.

For colouring maps, an amuſement both extremely agreeable and of great advantage, beſides the colours, gum water and tartar ley are principally requiſite.

Gum Water may be made in this proportion. Three ounces of the whiteſt and cleareſt gum arabic, beat ſmall, may be diſſolved in a pint of fair ſpring water: ſhake it two or three times a day very well. If there is any foulneſs in it, ſtrain it through a rag into a clean earthen diſh, and then bottle it for uſe. It ſhould be made freſh every two months; therefore ſmall quantities are beſt at once.

Tartar Ley is made in this manner. Wrap about two ounces of the beſt white tartar very tight in half a ſheet of brown cap paper, thoroughly wet; put it into a clear fire of wood or ſea coal, to remain till it is red hot, when it muſt be taken out with the tongs, and immediately put in a pint of water. Rub it well to pieces with your fingures, and put all into a long, narrow glaſs; in a day or two the clear ley may be decanted off, and, when put into a clean glaſs, kept for uſe.

Colours of a ſuperior brightneſs and luſtre are made as follows, peculiarly calculated for improving and embelliſhing maps.

A Copper Green is thus made. Take a quantity of the beſt French verdigreaſe, which beat into fine powder, with about one-fifth of cream of tartar, avoiding the fumes of the verdigreaſe by ſtuffing the noſe, and holding ſome fine linen in the mouth. Mix the powders in about five or ſix times their weight of water, which boil away in an earthen pipkin to half; and when cold, ſtrain it, putting the liquor into a glaſs, which ſtop up, and let it ſtand to ſettle till the liquor is very clear. If it ſhould not be deep enough, diminiſh it by a gentle heat over a few coals, and try its ſtrength by a ſlip of white paper. But it ſhould not ſhine too much; this will ſometimes make it neceſſary to boil it anew with ſome more verdigreaſe, ſo as to become a tranſparent, deep willow green. This colour will keep many years, if cloſe corked. A little quantity may be made in a ſmall pot or cup over a few hot embers.

A Stone-Colour is made by boiling an ounce of the beſt myrrh, in powder, in a pint of the tartar ley, till it is diſſolved. A ſhort time will do it; pour off the clear liquor, when ſettled, for uſe, keeping it cloſe ſtopped. It will never decay: boil away the liquor to make it deeper, or add water to make it fainter.

A Crimson Colour may be made with about 30 or 40 grains of good cochineal, bruiſed to fine powder in a gally pot, adding as many drops of tartar ley as will juſt wet it, and force the colour. Put half a ſpoonful of water to it immediately, or more, if it is too deep; you will have a delicate Purple Colour or Tincture. Scrape a very little allum into the tincture, and it will change into a delicate Crimſon; it ſhould be uſed ſoon, as it decays with keeping.

For a Blue, grind indigo very fine on a ſtone, with a little tartar ley; and when like a thick ſyrup, add gum water to it, and keep it in a glaſs cloſe ſtopped. When you uſe it, ſtir it up from the bottom.

Gamboge makes the beſt Yellow, in a lump of which make a hole with a penknife to put in ſome water; ſtir it well with a pencil, to make a faint or deeper yellow as you require. Pour it into a gally pot, and temper more till you have enough.

Red lead and orpiment may be had at the ſhops very finely ground, which temper with gum water for uſe. Blue bice needs only to be tempered in the ſame manner. Ultramarine, though dear, will go a great way with care, and may be mixed with a little gum water in a very ſmall gally pot.

Carmine is a very dear colour, but may be tempered to various degrees of crimſon with gum water, and ſhould be uſed with care. Vermillion is a beautiful ſcarlet, if ſo tempered; but it ſhews much brighter when dry, if glazed over with ſome thick gum water, in proportion of two ounces of gum arabic to half a pint of water, or leſs.

Burned umber, for ſome uſes, if ground very fine, and thick as poſſible, and then tempered with gum water to a proper thickneſs, makes a good tranſparent colour. A pleaſant GRASS GREEN is made by taking a lump of gamboge (as for yellow) and mixing in it ſome copper green; by ſtirring it with a pencil, it will change from a willow to a graſs green, and will be deeper or lighter, according to the time you ſtir it.

To Colour the Maps.

The diviſions in a map, which diſtinguiſh one kingdom from another, or one county from another, are known by certain lines or rows of pricks, or points of ſeveral ſizes and ſhapes, agreeable to the diviſions they are to denote. In a map of *Spain* and *Portugal*, for inſtance, the two kingdoms are ſeparated by a row of large points or pricks, and the ſeveral provinces (ſuch as we call ſhires in *England*) are diſtinguiſhed by lines of leſſer points. Then, to colour *Portugal*, cover the hills within the large pricked line with very thin tincture of myrrh, or tincture of Jeſuit's bark; and, where there are woods, dab every tree with the point of a very fine pencil dipped in graſs green, made with gamboge and copper green. In dipping your pencil, ſtroke it againſt the ſide of the pot or glaſs where your colour is, to prevent its dropping. The principal cities and towns may be marked with another pencil dipped in red lead, thinly tempered with gum water, that the eye may readily perceive them.

To trace out the bounds of the provinces, take another pencil dipped in copper green, which move along the inſide of the pricked lines, laying it evenly on. The next province may be coloured in like manner with gamboge, the next with the crimſon tincture of cochineal, the next with red lead, the next with graſs green, and then any of the former colours. Obſerve, that no two provinces muſt in any part join with the ſame colour; and that where the provinces join, the ſecond colour muſt not be laid on before the firſt be dry. The colours may be lightened off, or made fainter, when nearly dry, by wetting a clean pencil in water, gently ſqueezing it out, and going round with it on the inſide of the coloured line.

Note, That where any towns, trees, hills, &c, have been coloured before the bounds are marked out, thoſe places muſt continue, and not be coloured again with any other tincture or colour. Landſcapes may be coloured according to nature, as may all other devices or figures which are introduced to ſet off and embelliſh maps. Our limits will not allow us to be more particular; and therefore we ſhall only add in general, that the water and the bottoms of ſhips are to be tinged with thin indigo, the hull with umber, the ſails with tincture of myrrh, and the flags with vermillion or blue bice, according to their reſpective colours. The ſmoke of the guns may, where neceſſary, be done with very thin bice; and laſtly, the border or margin of the map may be coloured either with yellow, red, crimſon, or any other lively colour at pleaſure.

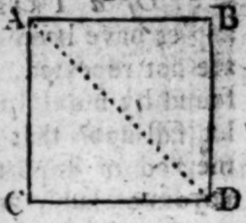
Of MEASURING.

MANY conſiderable uſes of this branch of learning have been already mentioned in the application of Duodecimals to artificers works, with ſpecimens of board and timber meaſure. The Young Meaſurer's Complete Guide, by the late Mr. Fenning, has been alſo referred to for further information. Our limits oblige us to be very conciſe, and therefore I ſhall briefly ſhew the nature of a few plain figures, preparatory to Surveying and Guaging, in order to ſhorten the obſervations on thoſe uſeful practical ſubjects.

The principal figures in ſuperficial meaſuring are ſquares or other four-ſided figures, triangles or three-ſided figures, with circles or their parts, and the ellipſis. Thoſe in ſolid meaſuring are cubes or other ſix-ſided figures, priſms, pyramids, ſpheres, and other circular ſolids.

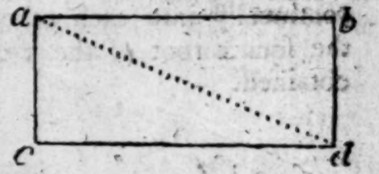
Of ſuperficial Figures, and how to find their Area.

Fig. 1.



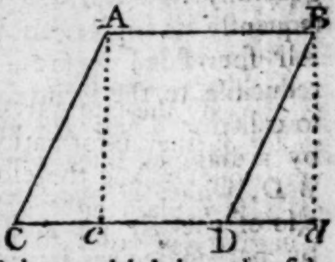
1. *Of a* **Square.** This is a figure of four equal ſides, at right angles with each other, the nature of which has been explained in the entrance upon Geometry, as the Figure A B C D, Fig. 1. Its content is found by multiplying the ſide into itſelf.

Fig. 2.



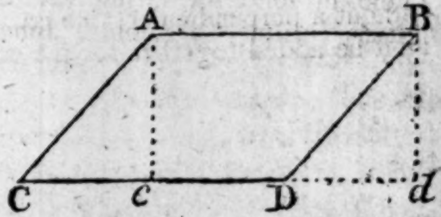
2. *Of a* **Parallelogram.** This figure alſo conſiſts of four ſides, and at right angles with one another, but the oppoſite ſides only are equal, as *a b c d*, Fig. 2. The length *a b* multiplied by the breadth *a c* will give the area.

Fig. 3.



3. *Of a* **Rhombus.** As this figure has alſo four equal ſides, it differs from a ſquare that none of its angles are right angles, but two obtuſe and two acute. Its ſhape is that of a diamond pane of glaſs, as the Figure A B C D, Fig. 3; and its content is found by multiplying the ſide of the rhombus A B into the perpendicular A *c* let fall from the obtuſe angle at A.

Fig. 4.

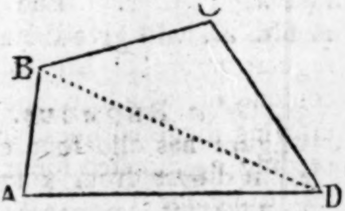


4. *Of a* **Rhomboides.** Its ſides are like thoſe of the parallelogram, from which it differs as the rhombus does from the ſquare, having

two obtuſe and two acute angles. Its content is alſo found by multiplying the longeſt ſide A B (ſee Fig. 4) into the perpendicular A *c* let fall from the obtuſe angle at A.

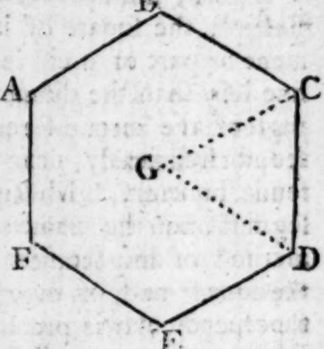
5. *Of a* TRIANGLE. As the ſeveral kinds of triangles have been given under Plain Trigonometry, they are not repeated. The content of all plain triangles is found by multiplying any ſide into half the perpendicular let fall upon that ſide from the oppoſite angle. Another method of importance to be known, eſpecially by ſurveyors of land, as every poſſible cauſe of error in taking a perpendicular is precluded, is as follows: add the three ſides together, and from half the ſum ſubtract each ſide ſingly, noting the remainders, which being multiplied continually into each other with the ſaid half ſum, and the ſquare root of the product extracted, the content is obtained.

Fig. 5.



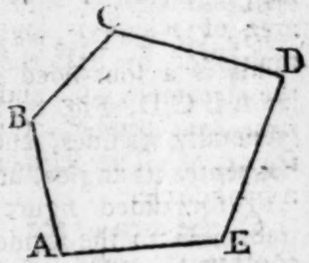
6. *Of a* TRAPEZIUM. This is a four-ſided figure, as A B C D, Fig. 5, having generally its ſides, and conſequently its angles, unequal. All four-ſided figures, not reducible to the former, are ſo called. They are uſually divided into two triangles by a diagonal line, which is a common baſe to both, as B D, which is one ſide of the triangle B C D, as it is alſo of the triangle A B D. It may be meaſured either by perpendiculars let fall from C and A reſpectively on the common baſe or diagonal B D, or ſingly by the preceding rule for a triangle without the perpendiculars. If it is done by perpendiculars, half their ſum multiplied by the diagonal will be the content; but if by triangles without a perpendicular, the content of the two triangles muſt be added together for the content of the trapezium.

Fig. 6.



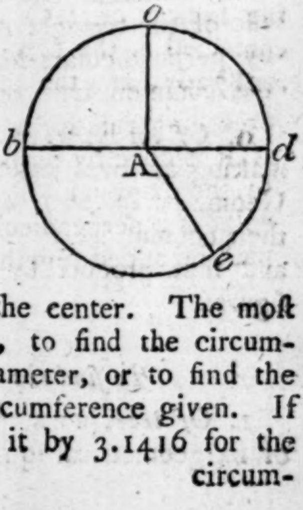
7. *Of* Polygons. *Regular* Polygons conſiſt uſually of a number of equal ſides, from five to twelve, and may be conſidered as making ſo many iſoſceles triangles, of which the ſide is the baſe, and the center of the circle on which the polygon is drawn is the oppoſite angle. Thus A B C D E F, Fig. 6, is a hexagon or regular polygon of ſix ſides, of which C D G repreſents one of the triangles; ſo that if the content of one triangle be found, that content multiplied by the number of ſides gives the content of the whole.

Fig. 7.



Irregular Polygons have their ſides and angles unequal, as A B C D E, Fig. 7, is an irregular figure of five ſides, the content of which is found by drawing diagonal lines, and proceeding as directed for triangles and trapezia.

Fig. 8.



8. *Of a* Circle *and its* Parts. A Circle is a figure perfectly round, and is formed by the motion of any ſtraight line, as A *d*, moving round one end of it, as A, the center of the circle *b o d e*, Fig. 8, of which *b* A *d* is called the diameter, paſſing from one ſide of the circle to the other through the center. The moſt general properties of circles are, to find the circumference and area, having the diameter, or to find the diameter and area, having the circumference given. If the diameter be given, multiply it by 3.1416 for the

circumference, and multiply the ſquare of the diameter by .7854 for the content or area; but if the circumference be known, multiply it by .3183 for the diameter, and multiply the ſquare of it by .0795 for the area. A ſegment or part of a circle is a figure terminated by a right line leſs than the diameter, called the chord line, and a part of the circumference; the area of which may be found ſufficiently near the truth without knowing the ſemi-diameter. Multiply the greateſt height of the ſegment by the number .626, and ſquare the product, and to this add the ſquare of half the chord line; twice the ſquare root of that ſum multiplied by two-thirds of the height will give the area or content. But, to be more exact, proceed thus. Square half the chord line, which divide by the greateſt height of the ſegment, and the quotient added to ſuch greateſt height will give the diameter of the circle, half of which is radius; from this ſubtract the greateſt height of the ſegment, and the remainder is the perpendicular of the triangle, bounding ſuch ſegment, of which the chord line is the baſe, the area of which is found as before. Then if radius be multiplied by half the length of the arch, meaſured on the circumference, and the area of the triangle be taken from that product, the remainder will be the area of the ſegment. The ſegment is here ſuppoſed to be leſs than a ſemi-circle.

Or the area of the ſegment of a circle may be obtained another way, by finding the radius, and the angle comprehending the area of ſuch ſegment, which may be eaſily had by Prob. VI. in Geometry, *p.* 268. Multiply the ſquare of ſuch radius by the number of degrees contained in the area, and that product by the decimal .0087267, and the area or content will be known.

9. *Of an* ELLIPSIS *or* OVAL. The various ways of making an oval have been ſhewn under Prob. VIII. of Geometry, *p.* 269, &c. and the beſt method of finding their content is, to multiply the length by the breadth, and that product by .7854. So much for ſuperficial figures.

To find the Content of Solid Figures.

1. *Of the* CUBE. This is a ſquare ſolid, compounded of ſix geometrical ſquares, and exactly in the ſhape of a

dye, the figure of which is well known. Its content is ſound by multiplying the ſquare of its ſide into the ſide, and the laſt product is the anſwer.

2. *Of the* PARALLELOPIPEDON. This is a ſolid figure, compounded of ſix parallelograms, the oppoſite ſides of which are equal. Or it may be called a priſm, the baſe or end of which is a parallelogram, and may repreſent a piece of timber or ſtone. As the length at the end multiplied by the breadth gives the area of a parallelogram, or the baſe, ſo that product by the whole length gives the ſolid content of the piece.

3. *Of the* PRISM. Though a parallelopipedon may be deemed a priſm, yet thoſe are generally conſidered to be ſuch only as have a polygon for their baſe, including the triangle and ſquare. In all priſms, whether triangular, ſquare, pentagonal, hexagonal, &c. the area of the baſe multiplied by the length will be the ſolid content. ——*N.B.* All the dimenſions muſt be of the ſame name or denomination, in this and the following ſolid bodies, or reduced to the ſame. If they are all inches, divide the product by 1728 for ſolid feet. But if the length is in feet, and the other dimenſions in inches, the length may be multiplied in feet, and the product divided by 144 for ſolid feet. This obſervation holds good of the following figures.

4. *Of the* PYRAMID. Theſe are of various ſorts, and are named as their baſes; all gradually diminiſhing to the top, where the ſeveral ſides terminate in a point. They are called triangular, ſquare, pentagonal, &c. and are generally, though not always, polygonal. The area of the baſe, whatever form they are of, multiplied by one-third of the perpendicular height, will give the content.

5. *Of the* FRUSTUMS *of* PYRAMIDS. Theſe are as various as the ſeveral pyramids, and are ſuch as do not terminate in a point, but ſeem to be cut off at ſome intermediate place. Such are many kinds of obeliſks, which are only continued to a certain height, gradually diminiſhing from the baſe; on which ſtatutes or other figures are frequently erected. To find their content,

add the ſquare of the ſide of the greater baſe to the ſquare of the ſide of the leſſer baſe, and alſo the rectangle of thoſe ſides. Multiply the ſum, if the baſe is a triangle, by .433; if a ſquare, by 1; if a pentagon, by 1.7204; if an hexagon, by 2.598, &c. as given at *p.* 244 of the Young Man's Book of Knowledge, by Mr. Fenning, laſt edition. That product multiplied by one-third of the height gives the content.

6. *Of a* CYLINDER. This is only a round column, the baſes being equal circles, and is exactly repreſented by a garden or field roller. The area of the circle at the baſe multiplied by the height will be the content.

7. *Of a* CONE. This is of the nature of a pyramid, but circular, and, like that, ends in a point. The content is found by multiplying the area of the baſe by one-third of the height.

8. *Of the* FRUSTUM *of a* CONE. This is alſo of the nature of the Fruſtum of a Pyramid, when the upper part of the cone ſeems to be cut off before it terminates in a point; of this ſort are many obeliſks, columns in buildings, &c. The method of finding the content is ſomewhat ſimilar to that for the fruſtums of pyramids, which is, by adding the ſquare of the diameter at each end to the rectangle of the two diameters, and multiplying the ſum by .7854, and that product by one-third of the height.

9. *Of a* SPHERE *or* GLOBE. This is known to be a round ſolid body, which is exactly repreſented by a ball. There are different rules for finding its ſolid content. Multiply the cube of the axis or diameter by .5236, and the product will be the content. Or, multiply the circumference by the axis, and the product will be the ſuperficial content, which alſo multiply by the axis, and the ſixth part of the product is the content. Other rules are ſometimes given, but they are not ſtrictly true.

10. *Of the* SPHEROID. Thit is nearly of the ſhape of an egg, each end of which is equally convex or full. It may be conceived to be formed by the revolution of an

oval or ellipſis about its tranſverſe or longeſt diameter. The content is found by multiplying the ſquare of the breadth or conjugate diameter into the length or tranſverſe diameter, and that product by .5236.

For the regular Solids, ſee *the whole Art of Meaſuring*, or *the Young Meaſurer's Complete Guide*, by D. Fenning.

Of SURVEYING.

THIS is an art ſo immediately depending upon Geometry and the Rules for Meaſuring juſt laid down, that I have aſſigned this place as moſt proper for treating it. Its utility is too well known to be commented upon. The gentleman, of courſe, wiſhes to know the quantity of acres his eſtate conſiſts of, and the farmer the admeaſurement of his different fields. Without ſome knowledge of the art of land-meaſuring, he can neither ſet out his acre of wheat for the reaper, or his turnips for the labourer he employs to hoe them.

It is my intention to aſſiſt my readers in this matter, by ſhewing a plain, eaſy method of finding the content of any piece of ground, of whatever form. For this purpoſe a gunter's chain, conſiſting of 100 links of an equal length, is commonly employed, and is the moſt general inſtrument in uſe. This is 22 yards in length, and conſequently every 25 links is equal to one pole, or five yards and a half. For common purpoſes this is ſufficient. Nor indeed is this always neceſſary; for it is very eaſy to find the content of any piece of ground, by taking its dimenſions in yards and parts of a yard. I ſhall ſhew the method of doing this both ways, firſt premiſing, that I ſuppoſe my reader to be acquainted at leaſt with Diviſion and Reduction, and in certain caſes of triangles it would be proper to know the Square Root; though the neceſſity of this is not to be maintained, becauſe it may be readily done another way, as will be ſeen preſently.

The firſt thing to be conſidered is, to take the dimenſions, as it is commonly called, *i. e.* the meaſure in length of ſuch ſides of the field or part of a field as are neceſſary; or the diagonals where the ſides are not regular, which it muſt be obſerved very few fields are. If the length on one ſide is equal to the length on the other ſide, and the breadth at both ends alſo equal, then the content in the denominations you meaſured in is had, by multiplying the length and breadth together as in a parallelogram; ſo that if you meaſured by links, this product will be ſquare links, which being divided by 100000 (the number of ſquare links in an acre) the quotient will be acres. N. B. This is done by cutting off five places of figures on the right-hand, and to find the value of the remainder, or figures ſo cut off, multiply them by 4, and cut off alſo five places, and if any figure be on the left hand, it will be roods; multiply thoſe again on the right, if any, by 40, and cut off as before for perches.

If in the inſtance already mentioned, the dimenſions were taken in yards by a line or ſtring, afterwards meaſured by a yard meaſure, then ſuch product would have been ſquare yards; and if this was divided by 4840 (the number of ſquare yards in an acre) the quotient would be acres. The remainder, if any, multiplied by 4, and divided by 4840, gives the roods; and that remainder multiplied by 40, and the product divided by 4840 as before, gives the perches.

Example 1. A piece of ground was meaſured, the length of which was 500 links, or 5 chains, and the breadth 200 links, or 2 chains; what is the content?

OPERATION.

$$\begin{array}{r} 500 \\ 200 \\ \hline 1|00000 \\ \hline \end{array}$$

The length and breadth are here multiplied together, and 5 places to the right hand cut off, as by the rule, and the figure on the left hand ſhews the content to be juſt one acre.

Example 2. A farmer agrees with a reaper to cut a piece of wheat, the length of which was 110 yards, and the breadth 44 yards; and being deſirous of knowing the quantity of ground it contains, is here requeſted?

OPERATION.

110
44

440
440

4840)4840(1 Acre, *Anſw.*
4840

Example 3. A farmer has a ſmall three-ſided field of the ſhape of a triangle, the three ſides of which meaſure 150 yards, 136 yards, and 120 yards; the content is here deſired to be known?

```
      150        203        203        203
      136        150        136        120
      120        ———        ———        ———
     ————         53         67         83
   2)406
     ————
      203
       53
     ————
      609
     1015
    —————
    10759
       67
    —————
    75313
   64554
   ——————
   720853
       83
  ———————
  2162559
  5766824
  ———————
  59830799(7735
  49 . . .
  ——
147)1083
    1029
    ————
1543)5407
     4629
     ————
15465)77899
      77325
      —————
        574
      —————
```

7735 *Square Yards*, which divided by 4840, the ſquare yards in an acre, and reduced as above directed, will give 1 *Acre*, 2 *Roods*, and 16 *Perches* nearly.

If upon the longeſt ſide a perpendicular be taken from the oppoſite angle, by means of a croſs ſtaff or quadrant ſtaff, it will ſtrike the angle oppoſite the baſe, at 89 yards from the extremity of the greateſt ſide ſubtending ſuch angle, or at 61 yards from the extremity of the leſſer ſide. Then meaſure the perpendicular, which is 103 yards, which multiplied into half the baſe will give the content nearly as above.

In the ſame manner the area of irregular four ſided figures, called Trapezia, muſt be found; or any other number of ſides, however irregular, by meaſuring diagonals, and making them the baſes of triangles. Or, for trapezia, by meaſuring the diagonals and taking perpendiculars, half the ſum of the perpendiculars multiplied by the diagonal gives the content.

Example 4. An irregular four-ſided field was to be meaſured, the diagonal of which was found to be 325 yards, and the perpendiculars (the neareſt diſtance from the angles being obtained by the croſs or quadrant ſtaff) 230 and 194 yards; what is the content?

230
194
2)424
212
325
1060
424
636
4840)68900 (14 *Acres.*
4840
20500
19360
114
4
4560
40
4840)182400 (37 *Perches.*
14520
37200
33880
3320

In the ſame manner may be found the content of any field whatever. If the above field had been meaſured with the chain, the dimenſions would have been nearly theſe, viz. the diagonal, 14 chains, 77 links; and the two perpendiculars, 10 chains, 46 links, and 8 chains, 82 links; and the operation as follows:

$$\begin{array}{r}
\text{Ch. Lin.} \\
10.46 \\
8.82 \\
\hline
2)19.28 \\
\hline
9.64 \\
14.77 \\
\hline
6748 \\
6748 \\
3856 \\
964 \\
\hline
14|2.3828 \\
4 \\
\hline
95312 \\
40 \\
\hline
38|12480
\end{array}$$

Note, It frequently happens that one ſide of a field may be an old boundary fence, or ſome brook, &c. may occaſion ſuch ſide to be very irregular; in ſuch caſe, in taking the dimenſions, take a ſtraight line as much within the limits of the field as poſſible, and calculate as before. For thoſe irregularities, take offſets to the amount of 8 or 10, and ſometimes 15 or 20, or more, as occaſion ſeems to require, the ſum of all which being divided by the number of offſets taken, will give a mean diſtance to be multiplied by the direct length of the line or ſide, to be added to the former for the whole content.

Here follow two tables for laying out an acre of ground by yards, of great uſe to many, and for converting yards into chains and links, or the contrary.

TABLE I.

The length in Yards and Inches required to make an Acre, according to any Number of Yards proposed in Breadth.

Breadth in Yds.	Length.		Breadth in Yds.	Length.	
	Yards.	Inches.		Yards.	Inches.
1	4840	00	36	134	16
2	2420	00	37	130	29
3	1613	12	38	127	13
4	1210	00	39	124	04
5	968	00	40	121	00
6	806	24	41	118	02
7	691	15	42	115	09
8	605	00	43	113	20
9	537	28	44	110	00
10	484	00	45	107	20
11	440	00	46	105	08
12	403	12	47	102	35
13	372	11	48	100	30
14	345	26	49	98	28
15	322	24	50	96	29
16	302	18	51	94	32
17	284	25	52	93	03
18	268	32	53	91	12
19	254	27	54	89	23
20	242	00	55	88	00
21	230	17	56	86	15
22	220	00	57	84	33
23	210	16	58	83	16
24	201	24	59	82	01
25	193	22	60	80	24
26	186	05	61	79	12
27	179	09	62	78	02
28	172	31	63	76	30
29	166	32	64	75	22
30	161	12	65	74	17
31	156	05	66	73	12
32	151	09	67	72	08
33	146	24	68	71	06
34	142	12	69	70	05
35	138	10	70	69	05

TABLE II.

The Number of Acres, Square Chains, and Parts of a Chain, each Chain being divided into 121 *Parts, contained in any Number of Square Yards.*

Square Yards.	Square Chains.	Parts.	Square Yds.	Square Links.
1	20	80	4840	1,00000
2	41	39	9680	2,00000
3	61	119	14520	3,00000
4	82	78	19360	4,00000
5	103	37	24200	5,00000
6	123	117	29040	6,00000
7	144	76	33880	7,00000
8	165	35	38720	8,00000
9	185	115	43560	9,00000
10	206	74	48400	10,00000
20	413	27	96800	20,00000
30	619	101	145200	30,00000
40	826	54	193600	40,00000
50	1033	07	242000	50,00000
60	1239	81	290400	60,00000
70	1446	34	338800	70,00000
80	1652	108	387200	80,00000
90	1859	61	435600	90,00000
100	2066	14	484000	100,00000
200	4132	28	968000	200,00000
300	6198	42	1452000	300,00000
400	8264	56	1936000	400,00000
500	10330	70	2420000	500,00000
600	12396	84	2904000	600,00000
700	14462	98	3388000	700,00000
800	16528	112	3872000	800,00000
900	18595	05	4356000	900,00000
1000	20661	19	4840000	1000,00000
2000	41322	38		
3000	61983	57		
4000	82644	76		

The uſe of theſe tables is evident; for if you wiſh to meaſure out an acre of ground, the breadth of which ſhall be 45 yards, you have the length 107 yards and 20 inches by the firſt table. In like manner, the uſe of the ſecond table is plain; by which the number of ſquare chains or acres in any known number of ſquare yards is obtained at ſight, from one yard to 1000 acres, which may be continued to any number at pleaſure. If the number cannot be taken out at once, extract it at twice, or at three or more times, if neceſſary, and add together. It has been noted already, that if five places of figures on the right hand are cut off, the figures on the left hand will from ſquare links become acres.

Of GAUGING.

OUR limits oblige us to be very brief in this branch of meaſuring. The ſame rules, therefore, ſhall ſuffice for computing meaſures of capacity, as for ſolid bodies of the ſame form already given. But there are ſome peculiar forms of veſſels, ſuch as caſks, tuns, &c. which, though they need no explanation as to their form, muſt be particularly conſidered.

For meaſuring caſks, take the diameters at the head and bung, and alſo the length, in inches, and then proceed thus. Find the areas of the circle at the bung, and alſo at the head, ſeparately, as taught under Meaſuring; and to two-thirds of the area at the bung add one third of the area at the head, which ſum, multiplied by the internal length of the caſk, will give the content of ſuch caſk in ſolid inches. Divide this by 231, if for wine gallons, or by 282, if for ale gallons; and the quotient will give the number of gallons in ſuch caſk.

Example. Suppoſe the bung diameter of a caſk to be 31.5 inches, and each head diameter 24.5 inches, and the length 42 inches; to find the content of ſuch caſk in ale gallons?

Firſt, The ſquare of the bung multiplied by .7854, gives 779.31315, two thirds of which is 519 5421 inches. *Secondly*, The ſquare of the head multiplied by .7854, gives 471.43635, one third of which is 157.14545.

Thirdly, Their ſum, multiplied by 42, gives the capacity of the caſk in inches, 28420.8771. *Laſtly*, Divide this by 282, and the quotient is 100 gallons, and a little more than 3 quarts.

The reaſon of giving ſo diſtinct an account of the operation is, that by directing the young ſtudent to find the area of the reſpective head and bung circles, the propriety of ſuch operation might be more clearly perceived. This being obſerved, we may naturally deduce from hence another general rule; which will not only render the multiplication by .7854 for reducing the ſquare to its inſcribed circle unneceſſary in one caſe, but in both. For if to two-thirds of the ſquare of the bung diameter, one-third of the ſquare of the head diameter be added, and that ſum being multiplied by the length, and the product divided by (what are uſually called the circular diviſors) 359.05 for ale gallons, and 294.12 for wine, the content will be had the ſame as before. Or, that product may be multiplied at once by .7854, and divided by 282 and 231, which will give the ſame.

Note, If a round tun is to be gauged, let it be done as taught for a cylinder, if the top and bottom are equal; if they are unequal, take the method given for the fruſtrum of a cone.

Here follows a table, by means of which, the dimenſions and content of the whole caſk being known, the liquor remaining in any caſk may be known when part is drawn off. But this is only for caſks which lay upon the bulge or ſide; though this is the moſt common way, except among large brewers, and therefore beſt calculated for general uſe.

A TABLE *for calculating the Contents of a Caſk, when partly drawn off, ſufficiently near for common Purpoſes.*

V. S.	Segment.	V. S	Segment.	V S.	Segment.	V. S.	Segment.
1	0,0017	26	0,2066	51	0,5127	76	0,8155
2	0,0048	27	0,2178	52	0,5255	77	0,8263
3	0,0087	28	0,2292	53	0,5382	78	0,8369
4	0,0134	29	0,2407	54	0,5509	79	0,8473
5	0,0187	30	0,2522	55	0,5635	80	0,8576
6	0,0245	31	0,2640	56	0,5762	81	0,8677
7	0,0308	32	0,2759	57	0,5888	82	0,8776
8	0,0375	33	0,2878	58	0,6014	83	0,8873
9	0,0446	34	0,2998	59	0,6140	84	0,8967
10	0,0520	35	0,3119	60	0,6265	85	0,9059
11	0,0598	36	0,3241	61	0,6390	86	0,9149
12	0,0680	37	0,3363	62	0,6514	87	0,9236
13	0,0764	38	0,3486	63	0,6637	88	0,9320
14	0,0851	39	0,3610	64	0,6759	89	0,9402
15	0,0941	40	0,3735	65	0,6881	90	0,9480
16	0,1033	41	0,3860	66	0,7002	91	0,9554
17	0,1127	42	0,3986	67	0,7122	92	0,9625
18	0,1224	43	0,4112	68	0,7241	93	0,9692
19	0,1323	44	0,4238	69	0,7360	94	0,9755
20	0,1424	45	0,4365	70	0,7478	95	0,9813
21	0,1527	46	0,4491	71	0,7593	96	0,9866
22	0,1631	47	0,4618	72	0,7708	97	0,9913
23	0,1737	48	0,4745	73	0,7822	98	0,9952
24	0,1845	49	0,4873	74	0,7934	99	0,9983
25	0,1955	50	0,5000	75	0,8045	100	1,0000

USE *of the* TABLE. In the caſk already given for an example, whoſe bung diameter is 31.5 inches, and the content 100.78 gallons, let 10 inches of the liquor be drawn off, ſo that the wet inches at the bung are 21.5 inches; what quantity of liquor is drawn off?

Rule.] Multiply the dry inches by 100, and divide the product by the diameter at the bung, and the quotient will be the number wherewith to enter the table. Then take out the number ſtanding againſt it, which multiply by the content of the whole caſk, cutting off from the product four figures on the right hand, when thoſe

Thirdly, Their ſum, multiplied by 42, gives the capacity of the caſk in inches, 28420.8771. *Laſtly,* Divide this by 282, and the quotient is 100 gallons, and a little more than 3 quarts.

The reaſon of giving ſo diſtinct an account of the operation is, that by directing the young ſtudent to find the area of the reſpective head and bung circles, the propriety of ſuch operation might be more clearly perceived. This being obſerved, we may naturally deduce from hence another general rule; which will not only render the multiplication by .7854 for reducing the ſquare to its inſcribed circle unneceſſary in one caſe, but in both. For if to two-thirds of the ſquare of the bung diameter, one-third of the ſquare of the head diameter be added, and that ſum being multiplied by the length, and the product divided by (what are uſually called the circular diviſors) 359.05 for ale gallons, and 294.12 for wine, the content will be had the ſame as before. Or, that product may be multiplied at once by .7854, and divided by 282 and 231, which will give the ſame.

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4	0,0134	29	0,2407	54	0,5509	79	0,8473
5	0,0187	30	0,2522	55	0,5635	80	0,8576
6	0,0245	31	0,2640	56	0,5762	81	0,8677
7	0,0308	32	0,2759	57	0,5888	82	0,8776
8	0,0375	33	0,2878	58	0,6014	83	0,8873
9	0,0446	34	0,2998	59	0,6140	84	0,8967
10	0,0520	35	0,3119	60	0,6265	85	0,9059
11	0,0598	36	0,3241	61	0,6390	86	0,9149
12	0,0680	37	0,3363	62	0,6514	87	0,9236
13	0,0764	38	0,3486	63	0,6637	88	0,9320
14	0,0851	39	0,3610	64	0,6759	89	0,9402
15	0,0941	40	0,3735	65	0,6881	90	0,9480
16	0,1033	41	0,3860	66	0,7002	91	0,9554
17	0,1127	42	0,3986	67	0,7122	92	0,9625
18	0,1224	43	0,4112	68	0,7241	93	0,9692
19	0,1323	44	0,4238	69	0,7360	94	0,9755
20	0,1424	45	0,4365	70	0,7478	95	0,9813
21	0,1527	46	0,4491	71	0,7593	96	0,9866
22	0,1631	47	0,4618	72	0,7708	97	0,9913
23	0,1737	48	0,4745	73	0,7822	98	0,9952
24	0,1845	49	0,4873	74	0,7934	99	0,9983
25	0,1955	50	0,5000	75	0,8045	100	1,0000

USE *of the* TABLE. In the caſk already given for an example, whoſe bung diameter is 31.5 inches, and the content 100.78 gallons, let 10 inches of the liquor be drawn off, ſo that the wet inches at the bung are 21.5 inches; what quantity of liquor is drawn off?

Rule.] Multiply the dry inches by 100, and divide the product by the diameter at the bung, and the quotient will be the number wherewith to enter the table. Then take out the number ſtanding againſt it, which multiply by the content of the whole caſk, cutting off from the product four figures on the right hand, when thoſe on the left hand will be gallons. If there is any remainder in ſuch right-hand figures, multiply it by 4 for quarts, and cut off four figures, when the figure, if any, on the left hand, will be quarts; and if there is ſtill a remainder, multiply it by 2 for pints, cutting off as before.

Thus, if 10 be multiplied by 100, and the product 1000 be divided by 31.5, it will give the quotient 35 nearly, againſt which in the table is .3119. Multiply the content 100.78 by it, which will give 31 gallons and 4332 for a remainder, which is ſomething more than 3 pints; and ſo much is ſuppoſed to be drawn out of the veſſel.

Note, This rule is exactly true for a cylindrical veſſel; but for caſks, where the difference between the head and bung diameters is conſiderable, there will be an error; for the veſſel will contain more liquor than this rule makes it, if it is more than half full, but leſs, if it is more than half drawn out. But if the difference betwixt the bung and head is not very much, the error will not be ſo great; and it may ſerve as a method proper to be adopted in common practice, though not ſtrictly true.

Some uſeful Information to the PUBLIC *in general, and to* MILITARY *and* ENGINEER OFFICERS *in particular.*

WE propoſed to have given ſome inſtructions relating to the Exciſe and Cuſtoms, which are the moſt conſiderable branches of the revenue; but they are under ſuch regulations, that any intelligence we can communicate muſt be very ſhort of the inſtructions which the reſpective officers are acquainted with by ſtated orders of government. On theſe heads, therefore, it is unneceſſary to enlarge; we ſhall only ſhew in this place the uſual method of finding the tonnage of ſhips, which may be the more acceptable, as by a late act of parliament all ſhips and veſſels are to be meaſured and regiſtered, on pain of ſeizure and condemnation.

To find the Tonnage of a Ship, or the Number of Tons which by Admeaſurement any Ship is ſuppoſed to be capable of carrying.

Rule. Meaſure the length of the keel, and of the midſhip beam within ſide, and alſo the depth of the hold, in feet; and having multiplied them into each other, divide the laſt product by 94, and the quotient will be the number of tons.

N. B. Veſſels which are moulded for the convenience of ſtowage, will uſually carry from one-third to one-fourth more than is given by this rule.

Example. If the length of a ſhip's keel be 46 feet, her breadth (or length of the midſhip beam) 23 feet, and her depth 11 feet; required the number of tons that ſhip will meaſure?

$$\begin{array}{rl}
 & 46\\
 & 23\\ \hline
 & 138\\
 & 92\\ \hline
 & 1058\\
 & 11\\ \hline
94) & 11638(123 \text{ Tons and about 3 Qrs.}\\
 & 94\cdot\cdot\\ \hline
 & 223\\
 & 188\\ \hline
 & 358\\
 & 282\\ \hline
 & 76
\end{array}$$

Hence, as noted above, by adding one-fourth, the true burden may be eſtimated at 150 tons or upwards.

To find the Number of Shot contained in a complete Pile, having the Number of the Baſe given in Length and Breadth.

This propoſition is of great utility to engineers and others, in taking an account of ordnance ſtores in any of his Majeſty's dock-yards, garriſons, &c. &c. And though I have ſeen tables ready calculated for this purpoſe, I have never met with a rule, by which, in defect of ſuch tables, the number could be aſcertained at once. However, from conſidering their pyramidical form, and the nature of ſquare numbers, I am happy in ſupplying that deficiency by deducing the following plain, practical rules, for finding the number of ſhot, without the help of any intermediate numbers; whilſt thoſe who may be in poſſeſſion of the rule, if any ſuch was ever publiſhed, which I much doubt, after peruſing an almoſt incredible number of authors in the different branches of the mathematics, &c. the merit of the diſcovery, if it has any, muſt be ſufficient to ſtamp upon it the character of original.

Rule 1. If the pile is ſquare, containing the ſame number in length as in breadth, add 1, or unity, to the number of ſuch ſide*, and multiply the ſum by ſuch number, taking half the product, which call A. Then multiply A by twice the number contained in a ſide, and divide the product by 3; and if to the quotient you add one-third of A, the whole number of the pile will be obtained.

Rule 2. If the pile contains more in length than in breadth, take the difference, and proceed with the breadth as for a ſquare pile; and having multiplied A by this difference, add the product to the former reſult for the ſquare pile, and the ſum will be the required anſwer.

N. B. The difference betwixt the length and breadth of an oblong pile of ſhot may be had at ſight, by ſubtracting 1, or unity, from the number of ſhot on the ridge of the pile.

---

* This addition may be conſidered as the ſum of the two extremes in Arithmetical Progreſſion, and the firſt part of the operation, as finding the ſum of the terms, ſee p. 187; the other part of the operation is deduced from the method of finding the content of ſquare pyramids, ſee p. 333; or the Young Meaſurer's Complete Guide, by Mr. Fenning, laſt edition, p. 138.

Example 1. What number of ſhot is included in a ſquare pile, each ſide of the baſe containing 28?

OPERATION.

28
1 Add
29
28
232
58
2)812
406 or A

406
56 or twice 28
2436
2330
3)22736
7578$\frac{2}{3}$
135$\frac{1}{3}$ or $\frac{1}{3}$ of A
7714 Anſwer

Example 2. What number of ſhot does an oblong pile compriſe, its length having 33, and its breadth 23?

23
1 Add
24
23
72
48
2)552
276 or A

276
46 or twice 23
1656
1104
3)12696
4232
92 or $\frac{1}{3}$ of A
4324

Then 33
23 Sub.
10

276 or A
10
2760
4324 Add
7084 Anſwer.

N. B. This pile will appear as a ridge, having 11 ſhot in length; hence one leſs, which is 10, will be the difference of the ſides.

Of SWIMMING.

AS an art of ſo much importance to the community and to individuals cannot be too generally known, no other apology can be neceſſary for diſſeminating knowledge which may prove the means of ſaving many lives.

Though an expert ſwimmer will jump at once into the water it is dangerous to the health to run in, as many do. On the contrary, a learner ſhould go in gradually; but if, in leaping in, he ſhould deſcend deeper than he chuſes, by attempting to turn on his back that will be prevented. This is of uſe to ſtop his going to the bottom, though a learner in prudence will not go out of his depth.

The proper poſture for ſwimming is, to have the head and neck upright, while the breaſt is advanced forward, and the back bent ſo as to lay down gently ou the belly. Then draw the legs from the bottom, and immediately ſtretch them out again; alſo ſtrike forwards with the arms, ſpreading them open, and then drawing them in towards the breaſt. By ſtriking forwards, firſt with the feet, and then with the hands, without any fear of laying along on the water, it will ſoon become eaſy and pleaſant. For though at firſt a learner may ſink down in the water, and be almoſt ſtifled in holding the breath, by the uſe of bladders or reeds, corks, &c. that difficulty will be ſoon overcome, if the water is not deeper than the breaſt, or ſhallower than the belly.

When a perſon can ſwim well in this way, he ſhould accuſtom himſelf to turn to the right or left. Stretch the palm of the right hand outwards, and the arm at the ſame time, drawing in the palm of the left hand as well as the arm. Thus may he turn to the left ſide, by inclining the head, neck, and length of the body to that ſide. By the contrary method he may turn about to the right.

To ſwim on the back, which a perſon may do a long time without tiring, lay down on the water, with the hands on the belly, ſtriking out and drawing in the legs ſucceſſively, within two feet of the water's ſurface. Much leſs water will be drunk in this way than by ſwimming on the belly, and the waves will be more eaſily paſſed through; there is alſo leſs danger of being entangled with weeds. Take care not to drop either foot to feel for the bottom, which is the ready way to ſink; neither lifting the knees too high, nor ſinking the hips and ſides too low. By the aſſiſtance of ſome perſon, or a bundle of corks or bladders, this will ſoon be effected. Though it is not neceſſary to move the hands much in ſwimming on the back, which is chiefly uſed againſt the waves, yet to advance conſiderably both ſhould be employed.

For avoiding boats, weeds, rocks, &c. incline the head and body to the ſide you would turn to, at the ſame time moving and turning the legs juſt as you would do upon land. To turn to the left, drive off the water with the palm of the right hand a little bent, but outwards from that ſide, at the ſame time with the left hand open and fingers cloſe, driving the water on that ſide backwards. If you wiſh to turn to the right, do the ſame things with the contrary hands. Take care that the legs are not open, and that you have a ſufficient depth of water not to hurt your back againſt the ground.

In ſwimming on the back, it is uſual to go backward, puſhing onward with the feet and legs. But to advance forward, let your breaſt be inflated, as your body is extended in a right line, with the hands upon the belly; and then lift up the legs one after another, drawing them back with all the force you can towards the hams, and ſo letting them fall into the water you will return to the place from whence you came. This greatly relieves a perſon when much fatigued, and is of great uſe at any diſtance from the ſhore.

It is eaſy to make a circle round the head as a centre, by ſinking a little that ſide of the body to which you would turn, alſo lifting up that leg firſt, and then the other ſucceſſively, and at each motion advancing the legs about twelve inches each towards that ſide. Take care not to lift the feet too high, which will ſink down the head, nor ſtrike the water too hard, if you would perform it agreeably. The parts of the circle deſcribed may be obſerved by the froth on the ſurface. By means of one leg and the arms, you may turn the head and the whole body round, as before, while the other foot remains immoveable as a centre.

A perſon who is expert in ſwimming can almoſt do any thing. We ſhall ſhew ſome of the leſs common performances in this art. If both the hands are faſt joined together, you may get forward by drawing them in firſt towards the breaſt, and ſucceſſively ſtriking them out, the legs at the ſame time being exerciſed as before. Thus a paſſage may be effected through weeds or reeds, &c. Or, if both hands are put behind the head, or on the back, by advancing forward the breaſt, keeping the neck upright on the water, and puſhing forward with the legs and thighs, as by the common way of ſwimming on the belly, you may make way. This is very uſeful in the cramp, or any other caſe where the hands cannot be employed. If both legs are bound by weeds, &c. by turning on the back, uſing the hands, and ſtriking the legs one againſt another, a perſon may gain the ſhore in that poſition.

If the cramp ſhould ſeize a leg, it ſhould be moved towards the hips, and held by the hand on the oppoſite ſide, at the ſame time ſwimming with the other leg and hand which are at liberty. By this means one may get rid of weeds generally; but if a perſon is wholly entangled, by imitating a dog he may commonly free himſelf. To do this, elevate and depreſs one hand ſucceſſively after another, and alſo the feet, drawing the water towards you with the hands, and driving it from you with the feet. Begin with the right hand and right foot, and then uſe the left hand and foot, and ſo on.

To keep one foot at liberty in the ſeveral manœuvres of ſwimming, is matter of greater difficulty than it appears to be; for the chin muſt be drawn in towards the breaſt, which muſt alſo be inflated, the palms of the hands extended and turned towards the bottom, and the other leg employed in the water; or, if one thing is omitted, the head immediately ſinks. But its ſatisfaction amply rewards the trouble of learning it. To hold a foot out of the water is very different; for both the hands muſt gather the waters together, ſtriking them under you and driving them off, whilſt the other leg muſt not be raiſed more than half, and the water frequently beat with it by quick and ſhort ſtrokes. Thus may any thing faſtened to the toe be carried acroſs a river. But this may be done better by holding up the hands; and to do this, care muſt be taken not to contract the thorax or breaſt, which would ſink a perſon, but on the contrary, by holding in the breath, to keep it filled as much as poſſible while the arms are held up. To hold both feet out of the water is more eaſy, which may ſeem paradoxical; and may not only remain in one place, but may get forward. This is done on the back, the ſmall of which muſt be bent; and the hands being on the belly, move the palms open to and fro, which ſerve as oars to ſupport the body till you examine your feet. Sitting upon the water is ſomething like this; for you are to take both legs in your hands, draw in your breath that the breaſt may be inflated, hold the head upright, and lift up ſucceſſively the arms and legs, and ſo ſuſtain yourſelf.

It is very curious to creep upon the water like a ſnake, but it is very uſeful to get clear of weeds. When you are upon the belly, caſt the arms and hands forwards as far from the breaſt as poſſible, and the feet (cloſe together) ſoftly backwards. The fingers muſt be cloſe, and the palms of the hands a little bent, and turned towards the bottom. In this poſition, draw the water towards the breaſt with the hands and arms; by this means the body will have time to advance farther, and a perſon may gradually and gently diſengage himſelf from weeds. But the hands and arms muſt not be uſed too vigorouſly, leſt he ſhould be the more entangled, and ſo be in danger of periſhing.

Some of the moſt curious artifices of this nature are thoſe of *ringing the bells, roaſting the gooſe, treading the water*, &c. &c. The firſt may be done either on the back or belly; if the latter, draw in your feet at once, and ſtrike them out forwards as before you did backwards, at the ſame time ſtriking the hands out backwards, and putting the body in an upright poſition. If the former, draw the legs in at once towards the hips, and, ſtriking them down towards the bottom, caſt the body forwards till you are turned on the belly; always taking care, in theſe manœuvres, that you have ſufficient depth of water, and that the bottom is free from weeds.

To roaſt the gooſe, either by turning from right to left, or the contrary; if the former, and you are then ſwimming on the belly, extend the right hand and arm as far before you as you can, turning your whole body towards the left, by lifting up your right hand towards the top of the water you will be on your back, from which you may turn again on your belly, and ſo continue as often as you pleaſe. Do the contrary, if from left to right. If the legs are kept cloſe together, and the arms ſtretched out right before the breaſt, at but a ſmall diſtance from each other, this may be done very ſpeedily.

Before you attempt to tread the water, you ſhould learn to ſtand erect in the water without touching the bottom. When you are in a ſwimming poſition on your back, with your legs extended, let your legs deſcend till they come to be perpendicular, when you muſt take them up again, bending the knees and drawing in your breath. The arms and hands, of which the back parts lie flat on the water by the ſhoulders, muſt be extended ſometimes on the one ſide, and ſometimes on the other; ſhut them ſometimes, turning the palms towards the bottom, with the fingers cloſe to one another, and hold the chin as upright as poſſible. Thus you may move the water round with your legs from you, the ſoles of the feet being perpendicular to the bottom. A perſon bound hand and foot, and thrown into the water, may uſe it; and thus may one, having the uſe of the hands, defend himſelf againſt another. If the bottom is full of ruſhes or weeds, the left foot may be held up by the right hand, and the contrary, changing thoſe holds by ſpeedily ſtriking down ſuch foot; and in like manner may the other be held up, and ſo the legs, as occaſion requires, may be diſentangled from weeds.

If, when you are in an erect poſition, you have a deſire to turn to the right, firſt embrace the water with the ſole of the right foot, and then with that of the left, at the ſame time inclining the body that way. Draw the water towards you as much as you can with the hands, and afterwards drive it off again; firſt drawing it with the left hand, and then with the right, and ſo ſucceſſively driving it back. Thus a perſon may turn round on every ſide, either to find a ſafe landing place, or to guard againſt an enemy.

It only remains to give a few directions for Diving, the utility of which needs no comment. You muſt firſt begin, ſtanding with your feet on the bottom; then riſing up, your head being bowed down that your chin may touch the breaſt, and the crown of it towards the bottom, hold the backs of your hands cloſe together right before it. Strike them down towards the bottom as ſwiftly as you can, and you will ſoon deſcend. Some perſons, in very deep water, will leap from a bridge or ſhip, either a little forwards or upwards, and ſo deſcend very ſwiftly, with the head perpendicularly downwards; but many accidents confirm the practice to be dangerous: it is therefore better to ſwim under water, being free from danger and very pleaſant. Having firſt dived down, by turning the hands back to back, and cloſe to one another, with the thumbs turned upwards, and the fore-finger towards the bottom, and thus extending them as ſwiftly as you can; to deſcend ſtill lower, ſtrike them down, while extended, lower in the water, but to re-aſcend, keep the palms of the hands open towards the bottom, as when you ſwim on your belly above water. But to ſwim in the middle, graſp the water forwards with both arms, attracting it towards the body, the thumbs being turned a little more towards the bottom than the reſt of the hands. A perſon may by this method ſeek for any thing at the bottom, or paſs from one ſhore to another unſeen.

To ſave a perſon in a ſtate of drowning, keep at a diſtance of ten or twelve feet, and do not lay hold of him till he is quite ſunk down, or has loſt the uſe of his ſight; becauſe if ſuch a one ſhould, in that caſe, take hold of you, your life will be loſt. But when you can ſafely attempt it, ſeize him by the hair, and draw him on your back, carefully obſerving that he does not entangle you; and ſo drawing him to ſome ſhallow place, or, by means of a rope faſtened to his body, the other end being on ſhore, he may be eaſily brought to land. Of this we ſhall ſay more, when we give the methods for recovering drowned perſons.

To return from the bottom of the water, proceed much in the ſame manner as before; but to turn one's ſelf in the water, the perſon who ſwims with one hand extended muſt puſh from him the water before him with his palm, drawing towards him with the cavity of the other palm the water which is behind him. When the hand is extended as far as it can be, ſhut or clench the fingers of ſuch hand, and the palm of that turned outwards. But in ſearching for any thing, it is neceſſary to ſwim about the place, if not immediately perceived; to make a circle, therefore, beginning at the right and ending at the left, graſp the water with both hands from right to left, and the contrary if you would turn the other way. Never deſcend ſo far as to loſe the light; when that begins to fail, you may conclude you are either too deep, or under ſome veſſel, or the ſhore or ſhelving rock, &c. When you find this to be the caſe, recollect whereabouts you are, or which way you came thither, and turning back, look upwards for the light. Never attempt to breathe under water.

Sometimes it may be neceſſary to manœuvre, to avoid any perſon laying wait for your coming up. After two or three ſtrokes dive down, the deeper the better, if you have light, when you may either ſwim forward, or keep under water in the ſame place as long as you can hold your breath; when you can hold it no longer, come up to breathe, and then dive again as often as may be neceſſary. In ſummer a perſon may ſwim eighty yards under water without taking his breath; this might ſave many lives, and is uſeful for avoiding many dangers. This is called the dolphin manœuvre.

On Reſtoring LOST ANIMATION.

THERE are ſo many ways in which the powers of Animation may be ſuſpended, and ſo many lives are ſuffered to periſh, for want of adminiſtering proper helps, that every endeavour to aſſiſt the ignorant with ſuitable means of reſtoring the vital powers, when apparently loſt, is entitled to a favourable reception.

Drowning may be conſidered as the chief, though not the only cauſe of this ſudden ceſſation of the vital powers. The preſent age is diſtinguiſhed for its philanthropy; and men of ſcience no longer confine their knowledge of the neceſſary aids for reſcuing unhappy mortals, whether from accident or frenzy, from a ſtate of death. The rewards which are promiſed and paid to all that are inſtrumental in the recovery of drowned perſons, and the pecuniary emoluments held out to encourage the attempt, as well as the pleaſure reſulting to the feeling mind, ſtrongly recommend to our notice this ſubject as not unworthy of our plan.

It is certain, from experiments, that life may be reſtored after reſpiration has for ſome time ceaſed. More than two hours have ſometimes elapſed before ſigns of life have diſcovered themſelves; but even ſuch caſes have been ſucceſsfully perſevered in, which is reaſon ſufficient not to give ſuch perſons over too haſtily.

The firſt ſtep, uſually, after diſcovering a body and getting it out of the water, is, to hold up the feet higher than the head, and ſo endeavour to drain ſome of the water out of it; but this will not always ſucceed. Dr. Mead recommended, after wrapping up the perſon warm, to blow tobacco ſmoak into the body, and to ſhake and roll it about, rubbing it in bed with warm cloths; for the great object in ſuch caſes is, to put the blood in motion by any means which can be thought of. Children may be held on the knee, wrapped up in a warm night gown, before the fire, their head being lower than the feet, keeping them in continual agitation, and gradually increaſing the fire till it burns very fiercely. When ſigns of life appear, volatile ſpirits or ſalts may be uſed with good effect: they may alſo be put into a warm bed or cradle, with a bottle of hot water at the feet, not to ſcald them, and a ſmall quantity of good brandy may be put into the mouth. Where tobacco is not at hand, a few blaſts of a pair of bellows have often brought a perſon in that ſtate to life, and by continuing with diſcretion and prudence have produced every ſign of reſtoration; after which a warm bed and proper care, as before mentioned, generally effect a perfect recovery. To rub the body all over with ſalt, particularly about the breaſt and joints, will by perſeverance commonly ſucceed.

Another good remedy is, for a perſon to blow with a pipe or tube into the mouth of one taken out of the water very ſtrongly for ſome time, ſo as to make the lungs heave and ſwell; taking care to pinch the noſtrils to prevent its return through the noſe, and there is ſeldom any fear of overdoing it in uſing this remedy.

As our limits will not admit of enlarging on this ſubject, the celebrated and philanthropic writings of Dr. Hawes and Dr. Fothergill muſt be referred to, and the directions publiſhed under the name and patronage of the

Humane Society, inſtituted for the recovery of drowned perſons. But theſe hints, it is preſumed, communicated in this manner, may excite the attention of ſome, to whom theſe gentlemen or their writings are little known; and perhaps may prove a means of diffuſing ſome uſeful knowledge on ſo benevolent a ſubject.

Many other caſes of ſuſpended animation may occur, where a ſimilar treatment may be ſerviceable. To fill the lungs with warm air has often been attended with ſucceſs in ſuffocations from charcoal, ſulphur, &c. We wiſh not to be conſidered as writing to inform medical gentlemen, otherwiſe the numerous advantages of this method might be made to appear with convincing powers.

It is conjectured by many eminent phyſicians, that the vital power never totally forſakes the principal vital organs, however it may deſert the external parts, ſo long as they retain the ſmalleſt degree of heat. What, therefore, have been generally conſidered as ſigns of death, muſt be very uncertain; nor are we to ſuppoſe that the pulſation of the arteries or reſpiration are totally extinguiſhed, though they become inviſible to the eye, and imperceptible to the touch; for we cannot affirm that any thing leſs than a beginning putrefaction can aſcertain the abſolute certainty of death.

To the additional inſtance already given of the poſſibility of recovery from the effects of charcoal, we may ſubjoin the caſe of apoplexies and fainting fits, and others ariſing from any violent agitation of mind. The effects of opium and ſpirituous liquors producing the ſigns of death have been counteracted and overpowered; a ſolution of tartar emetic conveyed into the ſtomach by a proper tube, or any other means to excite vomiting, will very frequently produce the happieſt effects. Convulſions in children, which often occaſion all the appearances of death, have been overcome by this means; and there is an inſtance on record of a girl about ſeven years old, who, being ſuddenly ſeized with a fit, and having before had a bad cough, was given over by the phyſician as irrecoverably loſt (the heart and lungs having not only ceaſed to perform their office, but the lips and cheeks being pale, and the temples ſunk), and was recovered as follows: A clyſter was adminiſtered to ſatisfy the afflicted parents, and the wriſts chafed with ſpirituous water, without any ſigns of life; then the ſoles of the feet were rubbed with ſtrong brine, which being continued for three quarters of an hour without intermiſſion, ſhe began to breathe, and the friction was then increaſed. After two or three deep inſpirations, the child was reſtored to life and health; the phyſician and the attendants being equally ſurpriſed as the happy parents were delighted. Dr. Buchan, in his Domeſtic Medicine, mentions his recovering a perſon taken up for dead by a fall from his horſe, after ſix hours endeavours, during the greater part of which time he hardly ſhewed any ſigns of life. Perſons ſtrangled, as well as thoſe ſtunned by a fall or blow, muſt alſo be treated nearly upon the ſame principles; wherein every method ſhould be tried to retain and preſerve the genial warmth, and, by increaſing it, to reſtore the vital powers to their due offices.

Such inſtances are ſufficient to ſhew how neceſſary it is that every means of recovery ſhould be uſed, and that perſeverance may ſometimes ſucceed beyond all hopes of ſucceſs; and, if poſſible, under the direction of ſome experienced medical gentleman, who might vary them as circumſtances ſhould ſeem to indicate. It is more than probable, that many children carried off by convulſions are prematurely numbered with the dead, by neglecting the means of recalling life; and perhaps many who periſh by accidents are really loſt for want of proper care.

It often happens in fevers, eſpecially in weak habits, where the debility is ſo great that the patient ſinks into a ſtate ſo nearly reſembling that of death as to deceive the attendants. This alſo may ariſe from exceſs of bleeding, or other means which have been tried with a view to reduce the fever; in both caſes, if volatiles, ſuch as eau de luce, &c. were applied to the noſe, rubbed on the temples, and often ſprinkled about the bed and in the room, and if hot flannels alſo, moiſtened with a ſtrong ſolution of camphorated ſpirit, were applied over the breaſt, and renewed every quarter of an hour, the undertaker might often be diſappointed, and a valuable member reſtored to ſociety, too often conſigned to the grave from ignorance or motives of intereſt. A tea-ſpoonful of the ſtrongeſt cordial ſhould be given every five minutes, as ſoon as the patient can ſwallow. Not only in theſe caſes, but in the ſmall-pox, when the puſtules ſink, and death ſeems to enſue, the ſame methods are highly proper, as well as in any other acute diſorder, when the vital powers are ſtopped from a ſimilar cauſe.

We are happy in having procured the following ſurpriſing inſtance of recovery from the effects of drowning; as perhaps its equal has been ſeldom, if ever, heard of.

On or about the 4th of September, 1777, Philip, ſon of Philip Hibbs, of the town of Romſey, Cooper, then about 8 or 9 years of age, fell into the water at Church-bridge, and was carried by the current for more than 200 yards under the houſes, and a conſiderable time after his cloaths were diſcovered by a perſon paſſing, without knowing what it was. Being got out, he was brought to the ſhop of Mr. John Bartlett, ſurgeon, an hour or more after the accident, to every appearance totally deprived of life, and ſtiff with cold; not the ſmalleſt pulſation remained, nor the leaſt ſymptom of life could be diſcerned. No time was loſt to inflate the lungs and inteſtines, and the abdomen and extremities were at the ſame time inceſſantly rubbed with ſalt; this continued above three hours, when at laſt a ſmall indication of returning life appeared by a hiccup in the throat. By continuing the inflation, and rubbing with ſalt as at firſt, farther ſigns of life were perceived by hiccups more frequently repeated. He was then put into a warm bed, and the inflation was ſtill unremittingly continued; a vein was afterwards opened, which in the courſe of an hour bled to the amount of about five ounces. A ſmall pulſation was ſoon after felt in the wriſt, when, having poured ſome brandy into his throat, a vomiting immediately enſued, and he was then in a very ſhort time reſtored. From the firſt commencement of this amazing operation to this ſtate of the patient, near ſix hours were ſpent with unremitting exertion; and the recovery, conſequent upon this ſingular perſeverance, was at laſt happily and wonderfully effected, to the utmoſt aſtoniſhment of every perſon preſent. The ſucceeding day he came down ſtairs, and joined his companions as uſual, without the leaſt inconvenience; nor did he experience the ſmalleſt recollection of what paſſed from the time of his falling into the water to the time of his perfect recovery. He was (Dec. 1787) alive and well, and conſtantly employed in the buſineſs of his father, who could atteſt, with many others, the authenticity of this account.

On the Nature of ANNUITIES *for Life,* LEASEHOLD ESTATES *for Life, &c. &c.*

IN proſecuting this ſubject, which with pleaſure is embraced in concluding this work, he tmoſt uſeful information may be expected. For though in ſome parts of this kingdom ſuch kinds of tenures are but little known, and as little underſtood, in others they are ſo common, that the utility of this branch of the work muſt be obvious at firſt ſight.

The learned Dr. *Halley*, of whom mention is made in other parts of this book, laid the foundation for future political arithmeticians to improve upon. For it is only by repeated experiments and obſervations that the probability of the continuance of life can be aſcertained; and, later writers have zealouſly and patriotically employed their pens in this department, which is intimately connected with the riches of every ſtate, viz. the gradual increaſe or decreaſe of the number of the people it contains.

As the modes uſually adopted for grounding the theory of annuities upon, are moſt natural in themſelves, and beſt proportioned to deduce ſuitable conſequences from; it may pehaps ſeem ſurpriſing to the reader to be informed, that the purchaſers of annuities on lives will frequently advance from one and a half to two years purchaſe upon lives of twenty years and upwards, beyond what the tables for this purpoſe do ſpecify. But as theſe are calculated from general principles, there muſt certainly be ſome other cauſe aſſigned for placing ſuch gteater value upon the life of perſons after this period. It ſhall be the preſent buſineſs of the author to ſhew the probable cauſe of this difference; and alſo to point out ſome other particulars, which, the more generally they are encouraged, will be productive of ſtill greater advantages to the nation at large in preſerving many lives to a longer period, and alſo to individuals, in cauſing a proportionable increaſe of the value of annuities granted upon lives.

In aſſigning to the reader the occaſion of this difference or advance in the value of annuities, it muſt be remembered, that the proportionate numbers of thoſe perſons who die from year to year through the ſeveral periods of life, have been neceſſarily taken from obſervations made in ſome great cities or towns. This has given riſe to the different values which have been and ſtill are placed to the account of perſons of mature age; for as it is reaſonable to ſuppoſe that thoſe who purchaſe annuities upon their own lives will at leaſt reſide in the country ſome part of the year, the advantages in reſpect of health and the continuance of life, which are very conſiderable, are certainly of great and momentous conſideration. And the ſame reaſon may be ſuppoſed to operate on the minds of thoſe who are purchaſers of the lives of others; which muſt enhance the purchaſes of which I am treating in ſuch a degree probably as has been mentioned.

Another reaſon may be given for this difference, which may alſo concur in operation with the laſt, that in ſeaſons of political plenty ſome purchaſers may be ſatisfied with making a lower intereſt of their money than others; this will always be productive of an advance of the original purchaſe, and cauſe the effect of which I am writing. But it will always in ſome degree produce this ſingly, and much more when it is conſidered in conjunction with the former.

Yet it is not intended to ſtop here. In ſurveying with an obſerving eye the political arithmetic of this kingdom, we now find ſome powerful antidotes againſt the decreaſe of population, ſuch as may be called new ſources of population and increaſe of inhabitants, which till an advanced period of the preſent century were totally unknown to this kingdom. The ſmall-pox, which formerly made ſuch ravages as to cut off every fifth or even fourth perſon attacked with it, is now, by the happy introduction of inoculation, checked in its career; and by means of the numbers of lives ſaved, a new ſyſtem of obſervations muſt neceſſarily ſuperſede the old, and a new ſtate of the number of perſons dying in each year muſt conſequently lay the foundation for a new ſet of tables of the probability of life in all ages. To this conſideration may be added the many lives which have been preſerved and reſtored to the community, by means of the numerous hoſpitals and other charitable foundations in the metropolis, and in almoſt every county in the kingdom. Such cauſes have certainly operated to enhance the value of annuities upon lives in a very conſiderable proportion.

If I may be indulged with hazarding another cauſe, which might operate to this ſalutary effect, I would inſtance in the gradual and rapid advances which the people of this kingdom are in general making to the free exerciſe of their rational faculties, and the proportional removal of the miſts of prejudice. To be more particular, the ſources and effects of diſeaſes incident to the human body, ſeem to be better underſtood amongſt the bulk of mankind than in former ages.

Having obſerved that tables have been formed from a careful attention to the bills of mortality, compared with the births, in cities and towns; I ſhall here proceed, notwithſtanding the proportional advantages of life in the country, to ſhew the uſe of them, according to the lateſt ſtatement which has been given of the decreaſe of lives of any proportionate number of births. For as the public muſt ſtill be content with ſuch tables as can be procured for them, it is ſcarcely to be expected, ſo comparatively great is the difference of country ſituations in reſpect of health, that any tables can be formed more generally correct than thoſe we now have. It muſt therefore be left to the judgment of perſons intereſted, to conſider whether any advance may be made in the purchaſe of annuities on lives, and how far *; as perhaps it nearly agrees, without any ſuch advance, in its preſent ſtate, to the London bills of mortality. Such then are the tables propoſed for the reader's information; in which I ſhall, 1ſt, give an account of the proportionate number of deaths in each year, and from thence, 2dly, deduce the ſeveral expectations of the contingency of life at different ages. After this I ſhall proceed to give a table, ſhewing the number of years in which an annuitant will have his purchaſe-money reimburſed, at the rate of intereſt he may propoſe to make of his money. And from hence ariſes another conſideration, which is, to find the preſent worth of ſuch annuity, according to the number of years purchaſe, which will diſcover the price to be paid for ſuch annuity; this will form

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* From obſervations made in ſmaller towns, ſuch as Norwich and Northampton, the chance of life is in favour of theſe towns in proportion of three to two.

another table, which is the table moſt uſeful, and to which the former are chiefly preparatory.

The method hereafter recommended of deducing the ſecond table from the firſt being new, the following is here given as the moſt uſual way; leaving it to the ſtudent's choice to adopt that which he thinks proper.

To find the Value of an Annuity upon a Life of a given Age.

Rule. Subtract the given age from 86, the ſuppoſed extent of human life, and find the preſent value of an annuity of 1*l.* at the given rate per cent. for that difference. Multiply this by the amount of 1*l.* for one year, and divide the product by the difference found, ſubtracting the quotient from unity or 1. Then divide this remainder by the decimal of the rate of intereſt, and this laſt quotient expreſſes the value of the annuity for that life as required.

N. B. Tables in like manner may be conſtructed for half yearly payments, by uſing the amount and intereſt of 1*l.* for half a year.

A TABLE *of the Probabilities of Life, from the lateſt Obſervations made at London.*

No. of Perſons.	Ages compl.	No of Perſons.	Ages compl.	No. of Perſons.	Ages compl.	No. of Perſons.	Ages compl.	No. of Perſons.	Ages compl.
1518 486 ſub.	born	522 7 ſub.	16	395 9 ſub.	32	242 9 ſub.	48	118 7 ſub.	64
1032 200 ſub.	1	515 7 ſub.	17	386 9 ſub.	33	233 9 ſub.	49	111 7 ſub.	65
832 85 ſub.	2	508 7 ſub.	18	377 9 ſub.	34	224 9 ſub.	50	104 7 ſub.	66
747 59 ſub.	3	501 7 ſub.	19	368 9 ſub.	35	215 9 ſub.	51	97 7 ſub.	67
688 40 ſub.	4	494 7 ſub.	20	359 9 ſub.	36	206 8 ſub.	52	90 7 ſub.	68
648 26 ſub.	5	487 8 ſub.	21	350 9 ſub.	37	198 8 ſub.	53	83 7 ſub.	69
622 19 ſub.	6	479 8 ſub.	22	341 9 ſub.	38	190 7 ſub.	54	76 6 ſub.	70
603 14 ſub.	7	471 8 ſub.	23	332 10 ſub.	39	183 7 ſub.	55	70 6 ſub.	71
589 12 ſub.	8	463 8 ſub.	24	322 10 ſub.	40	176 7 ſub.	56	64 6 ſub.	72
577 10 ſub.	9	455 8 ſub.	25	312 10 ſub.	41	169 7 ſub.	57	58 5 ſub.	73
567 9 ſub.	10	447 8 ſub.	26	302 10 ſub.	42	162 7 ſub.	58	53 5 ſub.	74
558 9 ſub.	11	439 8 ſub.	27	292 10 ſub.	43	155 8 ſub.	59	48 5 ſub.	75
549 8 ſub.	12	431 9 ſub.	28	282 10 ſub.	44	147 8 ſub.	60	43 5 ſub.	76
541 7 ſub.	13	422 9 ſub.	29	272 10 ſub.	45	139 7 ſub.	61	38 5 ſub	77
534 6 ſub.	14	413 9 ſub.	30	262 10 ſub.	46	132 7 ſub.	62	33 4 ſub.	78
528 6 ſub.	15	404 9 ſub.	31	252 10 ſub.	47	125 7 ſub	63	29	79

Explanation and Uſe. This table ſuppoſes that the obſervation was made upon 1518 perſons born; and that in conſequence ſo many perſons only remained alive at the completion of any particular year in life, as the number ſpecifies which is placed againſt the number of that year. Hence it appears, that more than half of thoſe which are born die before the end of three years; that not one-third live to complete their 19th year; not one-fourth attain to the age of 34; and not one-tenth to the age of 60*. For 747 remaining at the end of three years is leſs than half of 1518, 501 is not one-third of that number, 377 not ſo many as the fourth, and 147 not one-tenth part of the perſons ſuppoſed to be born. In like manner, the comparative chances of life at any other age may be collected from hence, and the proportional probability of their living to any ſubſequent age aſcertained. For if a perſon of 30 years of age, for inſtance, deſires to know the chance of his living to the age of 75, the numbers 413 and 48 will ſhew the proportion, that out of 413 perſons of 30 years, only 48 will attain to the end of 75 years of age, which is little more than a ratio of 1 to 9.

From hence may be inferred the probable chance of life at any age. For ſuppoſing the utmoſt extent of human life to be at 86, and that thoſe who live beyond that age may be conſidered as phenomena, which are inadmiſſible in general calculations; the ſeveral expectations of life at different ages muſt from thence be determined, as we have already ſhewn, ſo far as our limits permit, from which, at the ſeveral rates of intereſt, the preſent value of any annuity to continue for that time may be aſcertained.

PROBLEM. To find the probability or expectation of the continuance of a ſingle life at any particular period of ſuch life.

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* At Northampton, it has been obſerved, that more than one-half will remain alive at the end of the ninth year, and more than one-third at the end of the 37th year; ſuch is the great and pernicious influence of very great cities on health, and the advantages of reſiding in ſmaller towns.

Rule. Let the given age be ſought in the preceding table, and obſerve the correſponding number which ſtands againſt it; then look below in the ſame table for the half of ſuch number, or the neareſt to it, and obſerve the year which ſtands againſt it, from which ſubtract the given age, and the remainder will be the expectation of life for that age. In this manner the following table has been calculated.

A TABLE *of the probable Expectations of Life at different Periods.*

Age.	*Expectat.*	*Age.*	*Expectat.*	*Age.*	*Expectat.*	*Age*	*Expectat.*
1	15.86	21	26.85	41	17.86	61	10.08
2	27.66	22	26.28	42	17.50	62	9.66
3	31.55	23	25.72	43	17.12	63	9.25
4	33.66	24	25.16	44	16.75	64	8.83
5	34.90	25	24.61	45	16.43	65	8.50
6	34.95	26	24.05	46	16.14	66	8.20
7	34.95	27	23.50	47	15.86	67	7.90
8	34.75	28	22.94	48	15.57	68	7.60
9	34.35	29	22.44	49	15.21	69	7.30
10	33.85	30	21.94	50	14.86	70	7.00
11	33.30	31	21.50	51	14.50	71	6.66
12	32.75	32	21.06	52	14.14	72	6.33
13	32.15	33	20.62	53	13.71	73	6.00
14	31.50	34	20.21	54	13.28	74	5.65
15	30.80	35	19.86	55	12.78	75	5.30
16	30.10	36	19.57	56	12.28	76	4.96
17	29.45	37	19.14	57	11.78	77	4.58
18	28.80	38	18.78	58	11.28	78	4.18
19	28.15	39	18.41	59	10.72	79	3.70
20	27.50	40	18.14	60	10.42	80	3.20

From what has been already obſerved, the uſe of this table is obvious; concerning which it may be remarked, that it makes the ages of 6 and 7 years to have the greateſt probability of the continuance of life, though tables in general make the 9th and 10th years of age to be moſt valuable, and ſome the 5th and 6th. But as this entirely depends on the accuracy of the firſt table, which ſhews the annual decreaſe of lives; it may he ſufficient here to have ſhewn the method of deducing the expectations of life from thence, or from others which have a better claim to authenticity.

The next ſtep, in order to diſcover the preſent worth of an annuity upon any ſingle life, muſt be to find the diſcount of one year to come at the propoſed rate of intereſt; and the preſent worth thus found may be conſidered as a principal ſum for finding the next year's preſent worth, and ſo on for the whole time required. But theſe calculations ſuppoſe the certainty of life for ſuch time, whereas the contingency muſt be conſidered, and the probability of the perſon's life or death aſcertained; and from hence it is manifeſt, that the diſcount of any annuity for one year to come muſt be increaſed, that is, the preſent value muſt be decreaſed, in proportion to the decreaſe of the lives in that year; becauſe the contingency of the perſon's dying within that year leſſens the value of the preſent worth in proportion to that contingency. For though the preſent value of 1*l.* payable one year hence, at 5 per cent. is 19*s.* 0.571*d.* certain; yet, taking in the contingency of receiving the 1*l.* at the end of the year, that ſum muſt be leſſened in proportion to the numbers againſt any two ages differing only one year from each other. By proceeding in the ſame manner for the next year, and ſo on to the number of years which the probability of life points out for any certain preſent age; the ſeveral values added together will give the true preſent value of an annuity of 1*l.* at the ſuppoſed rate of intereſt for that time. If the contingency in each year is regularly deducted as above, the real preſent value of an annuity for any given age will be obtained; and from hence, by a very eaſy and natural proportion, the following table may be deduced. For as the preſent value of any annuity for a certain number of years is to that annuity multiplied by the number of years, ſo is the ſame number to the numbers reſpectively given in the table.

A TABLE *of the neceſſary Continuance of Life for reimburſing an Annuitant his Purchaſe-Money at ſeveral Rates of Intereſt.*

Years Purch.	2½ *p. Ct.*	3 *per Ct.*	3½ *per Ct.*	4 *per Ct.*	4½ *per Ct.*	5 *per Ct.*
	Y. D.	*Y. D.*	*Y. D.*	*Y. D.*	*Y. D*	*D. Y.*
5	5 149	5.182	5.216	5.252	5.289	5.327
5½	5.362	6. 37	6. 79	6 122	6.168	6.216
6	6 212	6,261	6.311	6.364	7. 55	7.113
6½	7. 66	7.124	7.184	7.247	7.314	8. 20
7	7.289	7.356	8. 62	8.137	8.217	8.303
7½	8.149	8.227	8.311	9. 34	9.129	9.231
8	9. 13	9.104	9.200	9.304	10. 51	10.172
8½	9 246	9.350	10. 97	10.217	10.348	11.125
9	10 218	10.236	11.	11.138	11.290	12. 92
9½	10.358	11.128	11.274	12. 69	12.245	13. 75
10	11.237	12. 24	12.191	13. 9	13 212	14. 75
10½	12.121	12.292	13.115	13.324	14.194	15. 94
11	13. 9	13.200	14. 48	14.286	15.190	16.134
11½	13.266	14.115	14.354	15.259	16.203	17.196
12	14.162	15. 36	15.305	16.246	17.234	18.285
12½	15. 64	15.329	16.265	17.246	18.285	20. 38
13	15.335	16 264	17.235	18.261	19.358	21.189
13½	16.246	17 206	18.216	19.292	21. 90	23. 13
14	17.163	18.156	19.209	20.340	22.215	24.247
14½	18. 85	19.115	20.215	22. 43	24. 5	26.168
15	19. 12	20. 82	21.234	23.132	25.195	28.151
15½	19.311	21. 59	22.267	24.245	27. 60	30.209
16	20.215	22. 45	23.816	26. 18	28.336	32.360
16½	21.197	23. 41	25. 16	27.185	30.300	35.164

Explanation and Uſe. The firſt column, which contains the number of years purchaſe, for every half year, from 5 to 16½, muſt be entered with the number of years purchaſe the annuity is ſuppoſed to be bought at. The other columns ſhew, in years and days, what time will be neceſſary for the annuity to produce the purchaſe-money according to the ſeveral rates of intereſt propoſed at the top of each column. Thus, if a perſon gives 13½ years purchaſe for an annuity, to know what time ſuch annuity will repay him at 4½ per cent. per annum for his money, againſt 13½ in the 1ſt column, and under 4½ per cent. in the 6th column, is 21 years and 90 days, and ſo long muſt the annuity be received to reinſtate the purchaſer thereof in his money. Hence, if we ſhould ſuppoſe the probability of the continuance of life of a perſon at any age to be 21 years and about a quarter, the full purchaſe would be no more than 13 years and a half, reckoning intereſt at 4½ per cent.

Again, if a perſon purchaſes an annuity, upon a life of 40, and gives 13 years purchaſe, it may be inferred from hence what rate of intereſt ſuch purchaſer will make of his money. For if you enter the table of the probable expectations of life with the age of 40, you will there find that it is 18.14 or 18 years and about 51 days. For this number you are to caſt your eye along the line of 13 years purchaſe, and the neareſt number to it is 18 years and 261 days; which being greater, ſhews that ſuch a purchaſer, according to theſe tables, will not have quite 4 per cent. for his money. But we have ſeen, that by the advance of about 1 year and a half in the purchaſe, if we look againſt 11½, you will find that the purchaſer of ſuch annuity will make more than 5 per cent.

From hence we collect another uſe of the preceding table. Having eſtimated the value of any life, by the probable expectation of the number of years to come, ſeek in the column under that rate of intereſt which is propoſed to be made for the number of years and days neareſt to it, and againſt it in the firſt column is the number of years and parts at which ſuch annuity muſt be purchaſed. For inſtance, if the expected continuance of the life of any perſon be 14 years, at what number of years purchaſe may an annuity on ſuch life be done, intereſt being allowed at 5 per cent.? Here in the 5 per cent. column I find 14 years and 75 days, or about one-fifth more, againſt which in the 1ſt column is 10 years purchaſe; and ſo much, or very little more, is ſuch an annuity to be valued at. But this will be more readily diſcovered by the following table.

A TABLE *of the Value of Annuities on a ſingle Life, at ſeveral Rates of Intereſt, for all Ages under* 80.

Age.	3 per Ct.			3½ per Ct.			4 per Ct.			4½ per Ct.			5 per Ct.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
8	19	14	8	18	3	2	16	15	9	15	11	10	14	10	10
9	19	17	4	18	5	4	16	17	7	15	13	5	14	12	1
10	19	17	4	18	5	4	16	17	7	15	13	5	14	12	1
11	19	14	8	18	3	2	16	15	9	15	11	10	14	10	10
7. 12	19	12	0	18	0	11	16	13	11	15	10	4	14		7
13	19	9	4	17	18	8	16	12	0	15	8	8	14	8	2
6. 14	19	6	7	17	16	5	16	10	1	15	7	1	14	6	10
15	19	3	10	17	14	1	16	8	2	15	5	5	14	5	5
16	19	1	0	17	11	9	16	6	2	15	3	9	14	3	11
5. 17	18	18	1	17	9	4	16	4	2	15	2	0	14	2	5
18	18	15	2	17	6	10	16	2	1	15	0	3	14	0	11
19	18	12	2	17	4	4	15	19	11	14	18	5	13	19	4
4. 20	18	9	1	17	1	10	15	17	9	14	16	7	13	17	9
21	18	6	1	16	19	3	15	15	7	14	14	8	13	16	2
22	18	2	11	16	16	7	15	13	4	14	12	9	13	14	6
23	17	19	9	16	13	11	15	11	0	14	10	10	13	12	10
3. 24	17	16	6	16	11	2	15	8	8	14	8	10	13	11	1
25	17	13	3	16	8	4	15	6	4	14	6	9	13	9	3
26	17	9	11	16	5	6	15	3	11	14	4	8	13	7	6
27	17	6	6	16	2	7	15	1	5	14	2	6	13	5	7
28	17	3	0	15	19	8	14	18	11	14	0	4	13	3	8
29	16	19	6	15	16	8	14	16	3	13	18	1	13	1	9
30	16	16	0	15	13	7	14	13	8	13	15	9	12	19	9
2. 31	16	12	4	15	10	6	14	10	11	13	13	5	12	17	8
32	16	8	8	15	7	4	14	8	2	13	11	0	12	15	7
33	16	4	11	15	4	0	14	5	4	13	8	7	12	13	5
34	16	1	1	15	0	9	14	2	6	13	6	0	12	11	2
35	15	17	3	14	17	5	13	19	6	13	3	6	12	8	11
36	15	13	3	14	13	11	13	16	6	13	0	10	12	6	7
37	15	9	3	14	10	5	13	13	6	12	18	2	12	4	3
38	15	5	1	14	6	10	13	10	4	12	15	5	12	1	9
1. 39	15	1	0	14	3	3	13	7	2	12	12	7	11	19	3
40	14	16	10	13	19	6	13	3	11	12	9	8	11	16	8
41	14	12	6	13	15	9	13	0	6	12	6	8	11	14	1
42	14	8	1	13	11	11	12	17	1	12	3	8	11	11	4
43	14	3	8	13	7	11	12	13	7	12	0	6	11	8	7
44	13	19	1	13	3	11	12	10	0	11	17	4	11	5	9
45	13	14	6	12	19	10	12	6	5	11	14	1	11	2	10
46	13	9	10	12	15	8	12	2	8	11	10	9	10	19	10
47	13	5	0	12	11	5	11	18	10	11	7	4	10	16	8
48	13	0	2	12	7	0	11	14	11	11	3	10	10	13	6
49	12	15	3	12	2	7	11	10	11	11	0	2	10	10	3
50	12	10	2	11	18	0	11	6	10	10	16	6	10	6	11

TABL

TABLE *continued.*

Age.	3 per Ct.			3½ per Ct.			4 per Ct.			4½ per Ct.			5 per Ct.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
51	12	5	1	11	13	5	11	2	8	10	12	9	10	3	6
52	11	19	10	11	8	8	10	18	5	10	8	10	9	19	11
53	11	14	6	11	3	10	10	14	0	10	4	10	9	16	4
54	11	9	1	10	19	0	10	9	6	10	0	9	9	12	7
55	11	3	7	10	13	11	10	4	11	9	16	6	9	8	8
56	10	18	0	10	8	10	10	0	3	9	12	3	9	4	9
57	10	12	3	10	3	7	9	15	5	9	7	10	9	0	8
58	10	6	6	9	18	3	9	10	6	9	3	3	8	16	6
59	10	0	6	9	12	9	9	5	6	8	18	7	8	12	2
60	9	14	6	9	7	2	9	0	4	8	13	10	8	7	9
61	9	8	4	9	1	6	8	15	0	8	8	11	8	3	2
62	9	2	1	8	15	8	8	9	7	8	3	11	7	18	6
63	8	15	8	8	9	9	8	4	1	7	18	9	7	13	8
64	8	9	2	8	3	8	7	18	5	7	13	5	7	8	8
65	8	2	7	7	17	6	7	12	7	7	7	11	7	3	6
66	7	15	10	7	11	1	7	6	7	7	2	4	6	13	3
67	7	9	0	7	4	8	7	0	6	6	16	7	6	12	10
68	7	1	11	6	18	0	6	14	3	6	10	8	6	7	2
69	6	14	10	6	11	3	6	7	10	6	4	7	6	1	5
70	6	7	6	6	4	4	6	1	3	5	18	4	5	15	6
71	6	0	1	5	17	3	5	14	6	5	11	11	5	9	4
72	5	12	7	5	10	1	5	7	7	5	5	3	5	3	0
73	5	4	11	5	2	8	5	0	6	4	18	6	4	16	6
74	4	17	0	4	15	2	4	13	3	4	11	6	4	9	9
75	4	9	0	4	7	5	4	5	10	4	4	4	4	2	10
76	4	0	11	3	19	6	3	18	2	3	16	11	3	15	6
77	3	12	7	3	11	6	3	10	4	3	9	4	3	8	3
78	3	4	2	3	3	3	3	2	4	3	1	6	3	0	8
79	2	15	6	2	14	9	2	14	1	2	13	5	2	12	9
80	2	6	9	2	6	2	2	5	7	2	5	2	2	4	7

Explanation and Uſe. From what has been obſerved of the former tables, the nature of this muſt be obvious at firſt ſight; ſhewing the value of an annuity of one pound at ſeveral rates of intereſt on any ſingle life from 1 to 80, from whence the value of any other annuity is had, by multiplying this value by the pounds in ſuch annuity. It will alſo be obſerved, that the ages of 7 and 12 are ſuppoſed to be of the ſame value; alſo of 6 and 14, 5 and 17, 4 and 20, 3 and 24, 2 and 31, 1 and 39. Hence alſo the age, whoſe life is of greateſt value, appears to be from 9 to 10. But to give an inſtance, let us ſuppoſe an annuity of 70*l.* intereſt being accounted at 4½ per cent. to be payable on a life of 2 years, or of 31 years of age complete, to find the value; where is found, in the firſt place, 13*l*. 13*s*. 5*d*. which being multiplied by 70, will give 956*l*. 19*s*. 2*d*. the value of an annuity of 70*l*. for the life of a perſon of 31 years of age, or a child of 2 years of age.

Leasehold Estates for Lives are commonly granted for 99 years, determinable on the deaths of a certain number of lives, uſually three; and generally renewable after one or two deaths, according to the cuſtom of manors.

It is of much importance to the tenants of leaſehold eſtates on lives to be acquainted with the real value of ſingle lives, in order to know the value of the joint lives, on which the poſſeſſion of ſuch tenures depend. The original expence of purchaſing ſuch leaſes muſt be conſidered; to which muſt be added all expences in buildings upon ground-rents, &c. for the preſent value advanced on ſuch premiſes; and from the ſuppoſed annual value of ſuch premiſes, the annual rent reſerved to be paid is to be ſubtracted, alſo the eſtimated annual value of what may be deducted on account of heriots, &c. Having thus aſcertained the neat annual income to ariſe from ſuch premiſes, the ſingle value of each life to be mentioned in ſuch leaſe, at the rate of intereſt ſuppoſed, is to be extracted from proper tables; and from hence the following rules are univerſally eſtabliſhed for finding the value of two or three lives.

Rule 1. To find the value of two lives upon a leaſe, take the ſum of the ſingle values of each life, and alſo the product, which multiply by the pounds * in the rate of intereſt (taking parts, if neceſſary) and divide the laſt product by 100; ſubtract this quotient from the ſum of the ſingle values, the remainder will be a diviſor with which to divide the product of the value of the lives, and the value of the joint lives will be expreſſed by the quotient. Subtract this from the ſum of the values of the ſingle lives, which will give the value of the longeſt.

Rule 2. To find the value of three lives upon a leaſe, multiply the value of the three ſingle lives into each other for a dividend; then multiply the value of the firſt and ſecond lives together, of the firſt and third, and of the ſecond and third, and from the ſum of theſe products ſubtract the reſerved dividend multiplied by the pounds * in the rate of intereſt and divided by 50, which ſhall be a diviſor; and the quotient thence ariſing will be the value of three joint lives. Then to find the value of the longeſt life, from the ſum of the three ſingle lives ſubtract the ſum of all the joint lives combined two and two (i. e. of the firſt and ſecond, the firſt and third, and the ſecond and third), and to this remainder add the value of the three joint lives; this produces the value of the longeſt of three lives.

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* If the decimal of the rate of intereſt be uſed as the multiplier, to divide by 100 will become unneceſſary.

As my limits will not admit of enlarging, I ſhall only give an example or two for exerciſing the preceding rules.

Example 1. Suppoſe I wiſh to know what additional value will be given to an eſtate of 30*l.* a-year, nett income, by adding a life of 31 years of age to another of 37, reckoning intereſt at 5 per cent. per annum? Here the value of 37 under 5 per cent. is 12*l.* 4*s.* 3*d.* for every pound, and that of 31 is 12*l.* 17*s.* 8*d.*; which in decimals are 12.2625 and 12.8833, and their ſum 25.1458. The product of the two values is 157.98, which multiplied by .05 gives 7.899; ſubtract this from 25.1458, and it leaves 17.2468 for a diviſor. Then divide 157.98 by this diviſor, and the quotient will be 9.16. This quotient is the value of the joint continuance of the lives, and if ſubtracted from 25.14, the ſum of their ſingle values, it will leave 15.98 for the value of the ſurvivor's life. From this remainder take 12.26, the value of the oldeſt life, and it gives 3.76, to be multiplied by 30*l.* the nett annual value of the eſtate; which will produce 112.8*l.* or 112*l.* 16*s.* for the additional value of a life eſtate of 30*l.* a-year, nett money, by adding a life of 31 to one of 37.

Example 2. Suppoſe two lives of 56 and 27 are upon a leaſehold eſtate of 30*l.* a year, nett income, and it is deſired to add a third of 6 years of age, to know what additional preſent value will be given to it, ſuppoſing intereſt at 5 per cent. per annum? Here the values of 56 and 27 under 5 per cent. are 9*l.* 4*s.* 9*d.* or 9.2375, and 13*l.* 5*s.* 7*d.* or 13.2791; alſo the value of 6 is 14*l.* 6*s.* 10*d.* or 14.3416. Then theſe three values multiplied together will give 1759.2222 for a dividend; alſo the value of the joint lives of the firſt and ſecond life, by the firſt rule, will be 7.4872, of the firſt and third it is 7.8136, and of the ſecond and third it is 10.5264. Their ſum is 25.8272, to be ſubtracted from the ſum of the values of the three lives ſingly, which is 36.8582; and to 11.031, the difference, add 6.5236, the value of the three joint lives, as found by the ſecond rule, and the ſum 17.5546 is the value of the longeſt of theſe three lives. Now the value of the ſurvivor of the two joint lives is 15.0294; hence the difference 2.5252 multiplied by 30 gives 75.756*l.* for the full additional value of a third life of 6 years, to two others of 56 and 27.

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* See the preceding note.

From hence the method of computing tables for ſhewing the value of joint lives, both for the time of their joint continuance, and alſo the value of the longeſt liver, is obvious; but this muſt ſuffice for want of room.

FINIS.

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